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ART. XLII.—*Recent Geographical work in the United States.*

A. REPORT OF THE CORPS OF ENGINEERS, U. S. ARMY.

THE report of the Chief of Engineers of the United States Army, Gen. A. A. Humphreys, presented to Congress in December last, enables the public to observe the valuable contributions which this corps is making to an accurate knowledge of the structure of the country. The chief work of this scientific body, in time of peace, is to superintend the construction and repair of the national fortifications, to devise and carry forward the improvements which commerce requires in the harbors, rivers and lakes of the country. Full details in regard to their work are given in the report referred to, but attention may here be called to some of the inquiries and examinations which have a general geographical importance.

(*a*) *The U. S. Lake Survey.*—The survey of the Great Interior Lakes, now under the direction of Major C. B. Comstock, U. S. Eng., has been in progress during the past year in Lakes Superior, Michigan, St. Clair and Champlain, and on the St. Lawrence river.

"In Lake Superior the survey of the Apostle Islands has been completed; the primary triangulation has been carried from Porcupine Mountains to Duluth, a distance of one hundred and twenty miles; the base line at Minnesota Point has been measured; the longitude of Duluth and St. Paul determined by telegraphic connection with Detroit; and longitude, latitude, and azimuth observations have been made at several primary stations in the west end of the lake.

In Lake Michigan the shore-line topography and hydrography have been carried on the east shore from Little Point Sable to New Buffalo, a distance of one hundred and forty miles, and on the west shore from Manitowoc to Oak Creek, south of Milwaukee, a distance of eighty-five miles, leaving but one hundred and twenty miles of shore-line to finish the lake. The off-shore hydrography has nearly kept up with the shore-line work.

A reconnaissance has been made, and stations erected for a triangulation, to connect Green Bay with Milwaukee, over a distance of one hundred and twenty miles, and a part of the angles measured.

Lines determined by azimuth and latitude are in progress down the two shores of the lake. The triangulation, hydrography and topography of Lake St. Clair have been completed.

A reconnaissance has been made, and nearly all the stations erected for a triangulation, reaching from the forty-fifth parallel (the northern boundary of New York) to the east end of Lake Ontario, and a part of the angles have been measured. The topography and hydrography have been carried from the forty-fifth parallel to ten miles above (south-west) Ogdensburgh.

In Lake Champlain surveys of Plattsburgh and Burlington Bays have been made, and the narrows have been surveyed for a distance of thirty miles from the south end of the lake.

In the office, besides the ordinary computation and plotting of the field-work, final chart No. 2 of Lake Superior, and a chart of Isle Royale, have been prepared for the engraver, and preliminary chart No. 3 of Lake Superior has been engraved on stone and published. Final charts Nos. 1 and 3 of Lake Superior, and final chart of St. Clair are now in progress.

The expansions of the 15-foot brass bar, and of the two base-tubes, have been determined; observations for difference of longitude have been made with Duluth, Minnesota; Washington, D.C.; Austin and Battle Mountain, Nevada; and Fort Leavenworth, Kansas. The Washington work has been reduced.

The meteorological work of the survey has been continued."

The preliminary report of Prof. S. I. Smith of New Haven, on the zoölogical results of the dredging which was carried on in August and September, 1871, is appended to Major Comstock's report.

The longitude of Detroit (site of the present Lake Survey observatory) has been determined as west of Washington $24^{m}\ 00^{s}.12 \pm 0^{s}.02$. The longitude between Detroit and Duluth, and between Duluth and St. Paul, has also been determined by telegraphic connection, but the result is not published. A map is given showing the progress of the survey, indicating how far the shores are triangulated, how far carefully surveyed, and how far the maps are ready for publication.

(*b*) *Wheeler's Survey in Nevada and Arizona.*—The exploration of the territory south of the Central Pacific R. R., embrac-

ing parts of Eastern Nevada and Arizona, which was begun in 1869 by Lieutenant Wheeler, Corps of Eng., has been in progress during the past year. An outline of the results was printed in this volume, p. 232.

(*c*) *Raymond's Survey of the River Yukon, Alaska.*—Capt. C. W. Raymond, Corps of Engineers, has made a reconnaissance of the river Yukon in Alaska, with especial reference to a determination of the exact position of Fort Yukon.

His report, with a map of the river, has been separately printed by Congress.

(*d*) *King's Survey of the 40th Parallel.*—The survey of the Fortieth Parallel, to which frequent reference has been made in these pages, is still in progress. A succinct account of all the work begun by this survey from March 22, 1867, to Oct. 3, 1871, by Mr. King, is printed in the report.

We cite the latter half of his Report on "the methods of work, the character of the problems investigated, and what I consider the chief results."

"The foundation of our explorations has been a continuous system of triangulation, carried from mountain-top to mountain-top, over the whole extent of our work, by theodolite observations upon stone monuments. These triangles have been located geographically, and their distances computed from a base and check-base, and a system of astronomical stations. Within the primary triangles a large number of secondary triangles were located, by a large theodolite, from the primary points, and from these, working always inwardly, a thorough system of minor triangles has been measured with the gradienter, and the topography filled in by compass and gradienter, basing the system upon 300-foot grade-curves, located approximately by the barometer. In connection with this, the altitude of all prominent mountain-peaks and localities upon the plains have been determined.

In the department of geology careful and actual sections have been made over the whole area; the superposition of the immense variety of irruptive rocks has been, in almost all cases, accurately determined; the dynamical questions, such as the build of mountains, the upheaval of chains, and the formation of mining districts and of mineral-bearing lodes, have received our careful attention.

An extensive series of observations was also made upon the present climatic conditions of the Great Basin, as regards its isothermal lines, annual and monthly averages of temperature, relative evaporation, and the outlines of storms and rainfall.

In the department of botany a very large collection has been made, resulting in the discovery of somewhat over a hundred species of plants new to science, in a complete knowledge of the distribution of timber, and the leading families of the Desert flora.

In zoölogy, the collection has been equally careful, and the results, according to Professor S. F. Baird, in whose hands they now are, are of interest and value.

The work embraces a very complete scientific examination of a section of country which traverses, from west to east, nearly the entire Cordillera system. The rocks at our eastern terminus are already those of the Atlantic formations, and are being extensively studied by a number of geologists.

In the department of mining industry our labors have been completely worked up, and the volume and accompanying atlas, embracing the elaborated results of our three years' study, is already printed, and being bound at the Congressional establishment [since published]. Also, the topographical maps of the fortieth parallel belt are plotted on a scale of two miles to the inch, and have been photographically reduced to a scale of four miles to the inch, resulting in three maps, about 30 or 40 inches each. These maps, assembled in grade-curves, are now being drawn in *hachure*, preparatory to lithographing them upon stone.

The volume of botany is completed, transmitted, and in process of printing. That of geology is also completed, and has been transmitted, and awaits the action of the Congressional printer, who is unable to keep up with our rate of furnishing material.

To complete the series, I propose two more volumes: one descriptive geology, and one embodying general results. That on descriptive geology is now in active preparation, and the geological maps accompanying it are already in the hands of the engraver.

These volumes, making thus far four, will be brought out as quickly as the printer can execute them. For the first, or general volume, I am unable at present to fix a definite time; its scope being somewhat unique, forbids a definite estimate.

When finished, the series is designed to embody, first, a groundwork topographical map, upon which shall appear all the features of the country surveyed; second, a series of geological maps, illustrating the formations of rocks, soils, alkaline deposits, and the distribution of arable land; third, a general report, which, in a synthetical manner, shall describe the history of the formations of that portion of the Cordillera, its original deposition in the primeval ocean, the evolution of continental features and mountains, the minute lithological structure of each family of rocks, and chapters upon the volcanic and glacial ages; and an attempt to explain the present physical conditions, and an account of a considerable climatic change now going on.

As appendices to this, the second, third, fourth, and fifth volumes will treat of technical geology, zoölogy, and mining industry.

(*e*) *Surveys and Reconnaissances of Western Rivers.*—Among the great variety of enterprises of this character with which the Engineer Corps are charged, the following, which were in progress during the year 1870–71, seem to us as of most general interest.

1. A survey of the Cumberland river under the direction of Major G. Weitzel, Corps of Engineers, which was made by Mr. S. T. Abert and a party of twenty-one men. The reconnaissance

extended from Nashville first to the river's mouth; afterwards from Nashville to the falls of the Cumberland.

The length of the river from the falls to the mouth is 595 miles. The following altitudes are of interest:

Foot of Falls,	770·70	above mean tide at Mobile.
Laurel River,	685·70	
Smith's Shoals—		
(Head),	651·70	
(Foot),	597·00	
Point Burnside,	597	
State Line,	502·50	
Nashville,	365	
River Mouth,	286	

A minute report of the character of the river, and of the resources of the region, is given.

2. A preliminary survey, under the same officer of Engineers, has been made of the *Wabash river*, from Wabash to its mouth, by Mr. F. Stien of Tipton, Ind.

3. An examination has also been made of the *French Broad river*, by Lieut. M. B. Adams, U. S. Eng.

4. A route has been surveyed for a ship-canal between Hennepin on the Illinois river, and Rock Island on the Mississippi, via Geneseo, showing a length for such a canal of 65 miles, with a navigable feeder from Dixon of 38 miles. The estimated cost of a ship-canal 160 feet wide and 7 feet deep is $12,500,000; and for a commercial canal 60 feet wide and 6 feet deep $3,900,000.

5. A series of examinations carried on under the direction of Lieut. Col. W. F. Raynolds, U. S. Eng., having reference to the improvement of the Mississippi river and its tributaries,—among them a survey of the Mississippi from Alton, Ill., to the mouth of the Maramec river, examinations of the Ouachita (Washita) and the little Missouri, one of its tributaries; and of the White, Black, Red and other rivers in Arkansas. These reports of surveys largely relate to the removal of obstacles to navigation; but they also contain much other information respecting the water courses and the adjacent territory. There is also a very interesting report on the vicinity of Vicksburg, "the key of the Mississippi Valley," called out by the apprehension, "too well founded," that the river will there seek a new channel, leaving Vicksburg an inland town.

6. On the Pacific Coast, river surveys more or less in detail have been made in various regions; including the Willamette, above Oregon City, by Maj. R. S. Williamson and Lieut. W. H. Heuer; the Umpqua; and portions of the Sacramento.

B. The Yellowstone Geysers.

The remarkable geysers which have been found in the valley of the Upper Yellowstone; the proposition which has been adopted in Congress to reserve a considerable portion of the valley most interesting for its natural characteristics as a public park, belonging to the nation; and the possibility that the Yellowstone Valley will be adopted by the Northern Pacific Railroad as their route for approaching the Rocky Mountains divide,—have recently attracted very general attention.

The most valuable sources of information which have come under our notice are as follows:

1. A picturesque description of the Geyser region, based upon the observations of the Washburne-Langford party, which was printed in Scribner's Monthly in 1871.

An account by Walter Trumbull of the Washburn Yellowstone expedition, was printed in the Overland Monthly for May, 1871.

2. The Reports of Dr. Hayden's visit in 1871, printed in this volume, pp. 161 and 294, with two illustrative maps, which are also prepared for publication on a larger scale.

3. The narrative of a reconnaissance by Capt. John W. Barlow of the Corps of Engineers, U. S. A., likewise made in the summer of 1871, published, by permission of Gen. Sheriden, in several of the daily newspapers of January and February, 1872.

4. The report of a railroad reconnaissance of the valley by Gen. Wm. Milnor Roberts, Chief Engineer of the Northern Pacific R. R., made in the summer of 1871,—a report which has been printed, but is not yet published, by the corporation just named.

C. Route of the Northern Pacific Railroad.

The prosecution of a second railroad route across the continent, by way of the Upper Missouri and the Columbia Valley, has added much to our knowledge of that country. This is the region which was first made known by the journey of Lewis and Clark in 1804–5 and 6; was surveyed by Gen. I. I. Stevens in 1853–4–5 (whose report was published as vol. xii, pt. 1, of the U. S. Pacific Railroad Report), and was again carefully examined by Capt. John Mullan, U. S. A., who constructed, from 1858 to 1862, a military road from Fort Walla Walla on the Columbia river to Fort Benton on the Missouri. The report of Capt. Mullan was printed by the Government in 1863.

1. The Northern Pacific Railroad published last year the report of a reconnaissance of the route made in 1869, by Gen. W. Milnor Roberts. The same engineer has been engaged during the summer of 1871 in an examination of the Rocky Mountain Divide, between Lewis and Clark's Pass on the north

and Deer Lodge Pass on the south, a distance of nearly 100 miles, covering all the passes of the main chain available for the Northern Pacific Road. He subsequently went down the Yellowstone, as mentioned before.

2. At the same time, Gen. Thos. L. Rosser has made a survey of a route between the Missouri at Fort Rice and the Yellowstone.

3. Mr. Frank Wilkeson also made last summer an examination of the geology of the region between Cadotte's Pass and Deer Lodge Pass, with reference to the occurrence of coal and iron.

4. Mr. Charles A. White has been across the Great Plain of the Columbia and through the Grand Coulée.

(These four reports have been printed, but are not yet published.)

D. Map of Transportation Routes in Minnesota and Dakota.

A map of transportation routes in Minnesota and Dakota, including railroads, mail and express routes, has just been prepared by Gen. S. R. Holabird, Chief Quartermaster of the Department of Dakota, and published on a scale of ten miles to one inch. The water courses, lakes, and routes of transit are carefully indicated, and the sites of settlements and villages; the heights of land are of course less accurately delineated. This vast region is now attracting so much attention and is so rapidly developing, that this preliminary map, prepared under circumstances of very considerable difficulty, is of special interest. The lakes which are so characteristic of Minnesota and Eastern Dakota, the line of the divide between the waters running to the Gulf of Mexico and those running to Hudson's Bay, the outlines of the Coteau des Prairies and of the Coteau du Missouri, and the line of the Northern Pacific Railroad, are among the interesting features which the map exhibits.

Art. XLIII.—*On Molecular and Cosmical Physics;* by Prof. W. A. Norton.

A recent review of a portion of the ground theoretically surveyed in my papers on Molecular and Cosmical Physics, published at intervals during the last eight years, has led to new results, which I now propose succinctly to present: and at the same time, for the proper understanding and appreciation of these, to sketch the outline of the general theory, and give a connected view of the results obtained. The theoretical deductions obtained in the papers alluded to have received many striking confirmations, which will first be briefly noticed.

One of the most conspicuous of the theoretical positions reached, was that of the incessant operation of a repulsive force, exerted at all distances beyond the minute sphere of molecular attraction, upon individual molecules. Evidence of the operation of such a force at small distances, in the contact of bodies whether by pressure or impact, has often been recognized, and it has generally been conceived to be the physical cause of the elastic outward pressure of gases;* but in both cometary and solar physics we have striking evidence of the operation of a force of repulsion upon the atoms of highly attenuated gases, at great distances. It is at present the general belief among astronomers that the tails of comets are composed of attenuated matter urged away to indefinite distances from the sun, by an energetic solar repulsion.† I think I may justly claim that my own researches, with reference to Donati's comet, have served materially to strengthen this conviction, long since entertained by such eminent astronomers as Olbers and Bessel.

The outstreaming of luminous vapors from the sun's photosphere, recognized by spectroscopists in the solar protuberances, and in the indefinite extension of the solar corona,‡ give intimation of a highly energetic repulsion of subtile vapors from the sun's luminous surface.

Another position taken was that the contiguous molecules of a liquid mutually repel each other; the equilibrium being maintained by a compressive force exerted inward at the surface—that to which the phenomena of capillarity are ascribed. Several striking experimental discoveries have recently been made, which furnish a strong support to this view. These are,

* Many eminent physicists, it is true, attribute the elastic pressure of a gas to the impact of its molecules, supposed to have a rapid motion in right lines, instead of a repulsive action exerted by them in a state of rest; but I shall endeavor to show in the sequel, that this fundamental principle in the kinetic theory of gases, has its essential counterpart in the impulsive waves of heat incessantly proceeding from the molecules. Besides, the advocates of this theory are constrained to admit the existence of a gaseous molecular repulsion, to account for the elastic reaction of the molecules in their mutual collisions.

† See Herschel's Outlines of Astronomy, eleventh edit., pp. 382–3; Loomis's Astronomy, pp. 262–3; and Norton's Astronomy, pp. 237–244.

‡ Prof. Young, in his article on the Solar Corona (this Jour., May, 1871), has this paragraph: "How extensive then is this leucosphere? Perhaps the question can hardly be answered definitely as yet; but it seems likely that it will be found to be at least from 8′ to 10′ thick on the average, with occasional prolongations of double that extent; not impossibly it may turn out to have no upper limit whatever, but to extend outward indefinitely into space." He asks how its enormous extent can be reconciled with the known smallness of the pressure at its base, and remarks in reply that "it may consist of some new kind of matter whose density is far below even that of hydrogen, or of matter whose specific gravity is diminished, annihilated, or even rendered negative by some such solar repulsion as appears to be operative in the formation of a comet's tail." The latter view is that which I have long advocated. (See this Jour., Jan., 1871; and June, 1871, p. 406).

1st, the discovery made by M. Tresca, that solids may be made to flow through orifices, like liquids, by subjecting them, when placed within a strong enclosure, to a great pressure; 2d, the discovery that if water be confined in a strong vessel, so that its tendency to expansion is restrained, the freezing point may be lowered 23° F.; 3d, that of Dr. Andrews, of the continuity of the gaseous and liquid states of matter, under certain experimental conditions.

The theoretical notion formed of a solid was also peculiar, and has been sustained by the results of my own experiments on the deflection of pine sticks, of various dimensions, under a transverse stress.* These served to reveal the inaccuracy of the ordinary formula for deflection, and to show the necessity of introducing a new term, which proved to be in accordance with the conception adopted of the mechanical condition of a solid, and at variance with that generally entertained. The same notion of the solid state, also led to the apparent detection of the actual play and mode of propagation of the molecular forces called into effective action by the bending force. The importance of these new views and results is fully recognized by Prof. De Volson Wood, in his recent treatise on the Resistance of Materials.

The special theory given of electro-magnetic and electro-dynamic phenomena, has derived support from the results of recent ingenious and delicate experiments made by Professor Alfred M. Mayer.†

It may be added that the fundamental hypothesis of a general mutual repulsion of atoms of matter, is in essential accordance with what a distinguished physicist terms the "modern idea that matter consists of a force of resistance from a center."

These statements have been made in the hope that they would serve to secure from the candid reader a closer and more interested attention to the brief exposition that is to follow.

I. Matter exists certainly under two, and probably under three varieties; viz., *ordinary* or *gross matter*, directly recognized by our senses; *universal* or *luminiferous ether*, filling all space, and pervading the interstitial spaces of all bodies of ordinary matter, the existence of which is inferred from optical pheno-

* See Proceedings of the American Association for the Advancement of Science, eighteenth meeting, pp. 47 to 63.

† Prof. Mayer, in his paper on the electro-tonic state, makes the following remarks: "It has always, however, appeared to me that the explanation of dynamic induction given by Prof. W. A. Norton (in this Jour., Jan., 1866) in his paper on Molecular Physics, affords a simpler and more satisfactory explanation of these phenomena than any heretofore framed."

mena; and *electric ether*, associated with all bodies of ordinary matter, whose existence is inferred from electrical phenomena.

These varieties of material substance may possibly not differ in their essential nature. It is at least conceivable that the atoms, so called, of ordinary matter, and of electric ether, are condensed groups of atoms of the universal ether; and hence that there is, essentially, but one form of matter in existence, viz., that which, as made up of single atoms homogeneously aggregated, forms the ether of space.

It may be that the electric ether, the supposed agent of electrical phenomena, may ultimately be shown to be identical with the luminiferous ether; but in the present state of physical science, they cannot be so regarded.

It is supposed by some physicists that electrical phenomena may consist in some mode or modes of motion of the atoms of ordinary matter, and that the forces of electric attraction and repulsion may originate in such motions. But this notion cannot be regarded as anything more than a conjecture: since no conception has hitherto been formed of possible atomic movements capable of originating the electric forces, and producing even the simplest of the electrical phenomena.

The existence of an electric ether has not been as conclusively established as that of the luminiferous, but all the phenomena give decided intimations of the operation of such an agent, and thus serve to confer upon the hypothesis of an electric ether a high probability.

Now that the ethereal is known to be one of the forms in which matter exists, and as we perceive that ordinary matter presents a great variety of substances differing in density, and other conditions, we may certainly just as reasonably refer electric phenomena to a special ethereal agent, as to hypothetical atomic movements of ordinary bodies of matter. The comparative availability of the two hypotheses in adequately representing the entire series of electrical phenomena, both formally and in their precise laws, is the only proper ground upon which we can decide to which the preference should be given.

II. All atoms of matter, when within a certain range of distance, attract or repel each other, either actually or virtually. In the normal condition of things, in the instance of each distinct body of matter, each of its constituent atoms is in a state of equilibrium, relatively to the rest, under the operation of all the forces, attractive or repulsive, exerted upon it by all other atoms within the range of sensible action. This is true of the universal ether, each atom of which is conceived to be at rest, so far as the natural action of other ethereal

atoms upon it is concerned; and this action is supposed to consist in a force of repulsion. It is also true of bodies of ordinary matter; but each integrant atom is under the operation of attractive as well as repulsive forces, exerted by other contiguous atoms—or at least of forces which tend to urge it from or toward the atoms acting on it. It is by virtue of this statical condition, and the change in the intensities of the effective forces when the relative distance of the atoms is altered, that all existing collections of matter are *media*, through which extraneous forces applied to them at any point are propagated to other points.

III. All atomic forces, whether operating at small or great distances, are of the nature of *incessant forces;* that is, are made up of impulses which are renewed every instant. In the case, certainly, of the forces propagated in the waves of radiant heat and light, and taking effect upon the atoms of bodies, the number of impulses received per second is not infinitely great, but capable of determination though enormously great. It is conceivable that all the other incessant forces in operation (gravitation, molecular forces, electric forces) are of the same essential character; that is, consist of, or result from *actual recurring impulses* propagated in ethereal waves. Upon this hypothesis these forces should conform to the law of inverse squares, like the radiations of heat and light; as they in fact do, in every instance in which the law of variation of intensity with the distance has been determined. The *effective* molecular forces may furnish an exception, but we have no reason to suppose that the law does not hold good for the actual attractive and repulsive forces from the antagonistic operation of which these effective forces result.

IV. In the light of these fundamental principles we may assume as the basis of an entire scheme of Nature, the hypothesis that all matter has but the one fundamental property of repulsion: and that the three great varieties of matter, and all the various substances known to us, differ essentially only in the mass, size, or perhaps in certain cases also the specific intensity of repulsion, of their atoms. We may reach a still deeper, underlying principle, by conceiving that all the atoms, so called, of ordinary matter, and of electric ether, consist of groups of atoms of the one primary universal ether, condensed by reason of a diminished repulsive action of their constituent atoms. This conception brings us to the simplest possible basis upon which a physical theory of inanimate Nature can be erected; viz., that of the existence of but one primordial form of matter and but one primary form of force.

The general inquiry now before us is whether the diverse

physical forces in operation, in their varieties of character and their established laws, the physical constitution and properties of bodies, and the different classes of physical phenomena, can be shown to be legitimately deducible from it. Certain topics comprised in this general inquiry will now be briefly discussed; in as far as this may be deemed necessary, to supplement the discussions given in former papers.

V. *Universal Gravitation.*—Let m, fig. 1, represent a single atom of ordinary matter, posited at any point in the sea of ether, and *cmd* a slightly divergent cone, extending from it in any direction; and let us consider the force that should take effect upon m resulting from the propagation of repulsive impulses from all the ethereal atoms lying within this cone. These propagated impulses may be regarded as superadded to the force of repulsion, which gives to the ether the essentially statical condition by virtue of which waves are propagated — though it does not appear to be absolutely essential that this latter force should be strictly a statical repulsion. Let *ab* and *cd* be portions of spherical surfaces, lying within the cone. Every atom in *ab* and *cd* will originate impulses of equal intensity; and hence the entire amount of force propagated to m from *ab* will be equal to that transmitted from *cd*. The same will be true for every other such spherical layer of atoms comprised within the cone. The entire wave-force conveyed to m will be the sum of the individual impulses proceeding from all the indefinitely thin layers of ethereal atoms, *ab*, *cd*, etc., of which the conical mass *cmd* is made up. The result is the same as if each layer *cd* was replaced by another of the extent *ab*, posited at the distance *ma;* and thus one immeasurably dense force-radiating mass obtained, at a certain assumed distance *ma*. The entire wave-force propagated to m should then be enormously great, even if the impulses emanating from the individual ethereal atoms be very feeble.

Now, for every wave transmitted to m, a certain minute fraction of the impulsive force conveyed in it, in the extent of the atom m, will take effect as an impulse against this atom. The equal reaction to this will originate a reflected ethereal wave, that will be propagated backward in all directions. If the cone *cmd* be extended indefinitely in the opposite direction, it will be seen that an equal impulsive force will take effect on m, from the waves transmitted from the ether lying within *c'md'*. These equal impulsive actions upon opposite sides of the atom will neutralize each other, and no motion can ensue. Every atom, m, then receives a certain impulsive action from the ethereal

waves that fall upon it, from any side; and in so doing *intercepts* a minute fraction of the wave-force, which passes back into the ethereal medium as a reflected wave.

2.

Let us now take two atoms m and n, Fig. 2, and let $c'nd'$ be a conical surface circumscribing n. It is plain, from what has just been stated, that a certain portion of the impulsive wave-force propagated to n, from the ether included within this conical surface, will be intercepted by n, and thus prevented from passing on to m. The impulsive action upon m received from the ether within the cone cmd, will then be in excess over that received from the ether posited within the cone $c'md'$, by the amount thus intercepted by n. The atom m should then gravitate toward n, by this differential force. Let a denote the amount of wave-force that falls upon m, from the cone cmd; a' the amount that falls upon n, from the conical frustum $c'nd'$; $\frac{a}{r}$ the amount of impulsive action on m due to the wave-force a; $\frac{a'}{r}$ that which takes effect on n, from the wave-force a'. The impulsive forces, $\frac{a}{r}$ and $\frac{a'}{r}$, will be intercepted by m and n, respectively. Let $\frac{a'}{r}=b$; and the wave-force from $c'md'$ that is propagated to m will be represented by $a-b$, and the impulsive action it exerts on m, by $\frac{a-b}{r}$. Then $\frac{a}{r}-\frac{a-b}{r}$, or $\frac{b}{r}$, will be the effective force by which m will gravitate toward n; for the entire gravitating force will be due to the conical portions of ether considered, provided all the points of m are taken into account. It is obvious that n will gravitate toward m with an equal force, if the two atoms are exact counterparts of each other.

It may be imagined that the deficiency, $\frac{b}{r}$, in the impulsive action received from $c'md'$, may be made up by the wave-force reflected back from n toward m, but this initial wave-force is diffused over the whole extent of the outspreading wave, and proportionally weakened at any one point, as m, which it reaches; and hence the portion that falls on m is but a minute fraction of the initial impulse, $\frac{a-b}{r}$, reflected at n toward m, and it is only the $\frac{1}{r}$ part of this minute fraction that can take effect impulsively on m. Suppose $\frac{1}{n}$ of $\frac{a-b}{r}$ is propagated to m,

then the impulse on m, from the reflected wave $\frac{a-b}{r}$, will be $\frac{a-b}{nr^2}$, whereas the gravitating force of m toward n is $\frac{b}{r}$, or $\frac{a'}{r^2}$; or, owing to the indefinite extent of the conical frustrum, $c'nd'$, not sensibly different from $\frac{a}{r^2}$ (for all the points of m). It is to be observed that $\frac{1}{n}$ will always be an exceedingly minute fraction, and therefore $\frac{a-b}{nr^2}$ excessively small, as compared with $\frac{a}{r^2}$.

It will be evident, on considering the varying size of the cones cmd, $c'md'$, as the distance $m\ n$ is supposed to vary, that the effective force of gravity, $\frac{b}{r}$, will conform to the law of inverse squares. It may also be shown, by means of the fundamental ideas just presented, that if we regard every atom of ordinary matter as made up of ethereal or other atoms of equal size (in accordance with our fundamental conception, p. 331), the entire force of gravitation of one body of matter toward another, will be proportional to the product of the masses of the two bodies, and inversely proportional to the square of the distance between their centers.* If we adopt the other possible conception, that an atom of ordinary matter is one continuous homogeneous mass, impenetrable at all points to the ethereal wave-force, then the force of gravitation of one atom, m, toward another, n, will be proportional to the surface of each; instead of the quantity of matter, or number of equal atoms in each. Upon this idea the atomic weights of substances would represent the comparative superficial dimensions of the atoms.

Let us now inquire what considerations can be urged in favor of adopting the theory thus briefly set forth of the possible origin of universal gravitation.

1. It is deduced from the simplest possible conception that can be formed of the essential elements of the material universe, viz., that they consist of one primary form of matter—the ethereal, and one form of force—repulsion; the actual existence of each of which is a well established fact. It is not, however, at variance with the notion that the atoms of ordinary matter are not made up of ethereal atoms; as we have just seen.

2. The hypothesis that the ethereal repulsion from which the force of gravity is derived is made up of definite impulses, leads to the law of inverse squares, as the law of propagation of the wave-force originated by it.

* See this Journal, Jan., 1870.

3. The effective force theoretically deduced, conforms to the established laws of universal gravitation.

4. The high improbability that the force of gravitation can take effect on cosmical bodies, and be transmitted through them without being in any sensible degree diminished, or intercepted, cannot be urged as an objection to the present view, since it is the very interception of a portion of the wave-force that gives rise to the effective gravitating tendency.

5. The conclusion reached by Laplace, that the velocity of the gravitating fluid, if such there be, must be immeasurably greater than the velocity of light, does not militate against the present theory. For when we consider that the gravitation waves are supposed to proceed from all the atoms of the sea of ether to an indefinite distance, it will be seen that the number of impulses that take effect on any atom, m, of ordinary matter, must be regarded as infinitely great in any finite time; and hence, that if we represent the action of these waves in any line of direction, by the progressive motion of a line of atoms impinging upon m, the velocity of this motion must be conceived to be infinite. The velocities of the earth and moon in their orbits must be wholly insensible in comparison with this representative velocity of an impinging fluid; and no augmentation of ethereal impulses can result from these velocities, that will be any sensible fraction of the entire impulsive action, or indeed of the differential action that constitutes the effective force of gravity.

6. If these be legitimate conclusions, then it would appear that the necessity does not exist of supposing the medium of gravitation to be a distinct ether, immeasureably more subtile than the luminiferous ether. It may be imagined, however, that the ready transmission of the force of gravitation through bodies necessitates this supposition. But, when we reflect that there are certain substances through which the waves of heat pass with facility, and that when absorption of any of the solar radiations occurs it is chiefly by reason of certain accordant rates of vibratory movement induced within the absorbing medium, it does not seem unreasonable to suppose that the mechanical conditions required for a similar absorption of the gravitation-waves may be wholly wanting in all substances. The only intercepting action would then be that already considered, from which the gravitating tendency results.

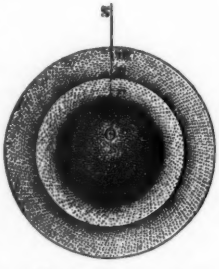
Let it not be supposed, however, that there is any theoretical objection to the notion of a separate gravitation-ether; farther than that we have no independent evidence of the existence of an ether more subtile than the luminiferous, and that the arbitrary hypothesis of such a medium does not seem to be demanded by the phenomena. If the hypothesis were adopted,

the hypothetical ether would simply play the part here assigned to the luminiferous ether.

VI. *Physical Constitution of a Primitive Molecule.*—A primitive molecule is here regarded as the physical equivalent of a "chemical atom," or simple "integrant atom," as these terms are ordinarily understood. The prevalent notion has been that a simple atom is inherently endued with the property of attraction or repulsion, which it manifests under different circumstances; but against this hypothesis rests the objection that it is highly improbable that a homogeneous atom can, of its own nature, exert a force of repulsion at one distance and of attraction at another. This fact, together with a careful study of physical phenomena, has led certain able physicists to regard an atom, so called, as made up of dissimilar parts. Now we are conducted to a notion of the physical constitution of an atom (primitive molecule) that accords with this idea, if we follow out the consequences of a universal force of repulsion. The impulsive "waves of translation" that are propagated to any atom of ordinary matter, from the universal sea of ether, should condense the surrounding ether upon its surface, and thus form a permanent ethereal atmosphere around it. This theoretical result, it should be observed, is in accordance with one of the inductions of Physical Optics.

Again, the electric ether, the supposed agent in electrical phenomena, cannot be very much less subtile than the luminiferous; if so, a portion of it posited in the vicinity of an ordinary atom, should be condensed around it by the ethereal waves, and form an *electric envelope*, immersed in the ethereal atmosphere, as roughly indicated in fig. 3. The electric ether, in this movement, should be borne forward, in a good degree, as if it were a portion of the ethereal medium of the wave propagation, but partly also by a gravitating tendency toward the atom, originated in the same way as that of one atom of ordinary matter toward another.

3.



Now it is to be observed that both the ethereal atmosphere and electric envelope of the atom are in a condition of dynamic equilibrium. The forces urging the atoms of the envelope toward the central atom are made up of actual recurring impulses; and the same is true of those condensing the ethereal atmosphere. Every such momentary condensation of this atmosphere must originate increased repulsive impulses exerted by this atmosphere upon the portion of the envelope exterior to it. Also, by our fundamental hypothesis, the ethereal

atmosphere and the central atom must act directly by recurring impulses upon the electric envelope. Every atom of this envelope must then be incessantly urged inward by one set of impulses, which virtually constitute an *attractive force* exerted by the central atom; and incessantly urged outward by another set of impulses which constitute a *repulsive force* exerted by the ethereal atmosphere and the central atom.

The center of the virtual attraction of the atom for its envelope is at the center of the atom. But, with respect to the action on any radial line, as *rs*, fig. 3, the center of the repulsion exerted by the ethereal atmosphere upon the envelope is not coincident with the center of the atom, but lies at some different point *o*, on the side considered. This results from the fact that the atom intercepts a part of the repulsive force propagated from the portion of this atmosphere posited on the opposite side of it. It follows from this relative position of the two centers of action, that the envelope can have no definite outer limit, but must extend with diminishing density indefinitely outward. Still, from most points of view, a virtual limit may be said to exist.

This is the state of the case for a single isolated molecule. If we consider two contiguous primitive molecules of a solid, or liquid, their actions on the electric ether in the interstitial space between them, do not in general neutralize each other, and determine an electric vacuum there; for their oblique actions on the ether lying on either side of the line of their centers will obviously tend to condense it upon this line. At the surface of every body there must also be more or less of condensing action that will occasion a certain density of the electric ether, at those special interstitial points of the body at which the attractive actions of surrounding molecules upon the ether neutralize each other.

VII. *Molecular Forces.*—The impulses of the virtual attractive force which, we have just seen, will be exerted by an atom upon its envelope, must originate at every point of the envelope a series of *attractive* waves that will be propagated indefinitely outward, by the interstitial electric ether, to surrounding atoms of the body. The resultant wave-system that may be taken to represent the entire system of waves thus originating on any one radial line, *rs*, fig. 3, will obviously proceed from a point lying much nearer the inner than the outer surface of the envelope; as at *n*. The action of these attractive impulses upon the envelope will also be attended by momentary condensations of the ethereal atmosphere below it; and therefore will originate waves in this atmosphere that will be propagated indefinitely outward by the interstitial luminiferous ether. These waves will be repulsive in their character.

The force thus originating I designate as the molecular force of *heat-repulsion;* but it should not be confounded with the heat energy in the body, derived from extraneous sources, or from work of condensation previously expended in the interior of the body. Again, the repulsive impulses exerted, as we have seen, by the ethereal atmosphere upon the envelope, must take effect upon every point of it, and the outward pressures thus originating at the various points of any radial line, *rs*, will combine to produce a greater and greater outward condensing action at points more and more remote from the lower surface of the envelope, within a certain limit. From each of these points of varying condensation will proceed indefinitely outward, through the interstitial electric ether, a series of repulsive waves. These may be represented by a resultant wave-system, which must obviously be regarded as proceeding from a center nearer the outer then the inner surface of the envelope, as at *m*, fig. 3. This resultant system of repulsive waves, as it originates in the electric envelope, and is propagated by the interstitial electric ether, is termed the molecular force of *electric repulsion.*

The result then is, that *the molecular forces consist of one attraction and two repulsions;* all originating in the primary force of repulsion. They are made up of impulses propagated in waves; and hence must observe the law of the inverse ratio of the square of the distance.

From these fundamental results I have deduced in my former paper on Molecular Physics, the following general analytical expression for the intensity of the effective action of one primitive molecule on another, in terms of the distance, x, between the envelopes of the two molecules;

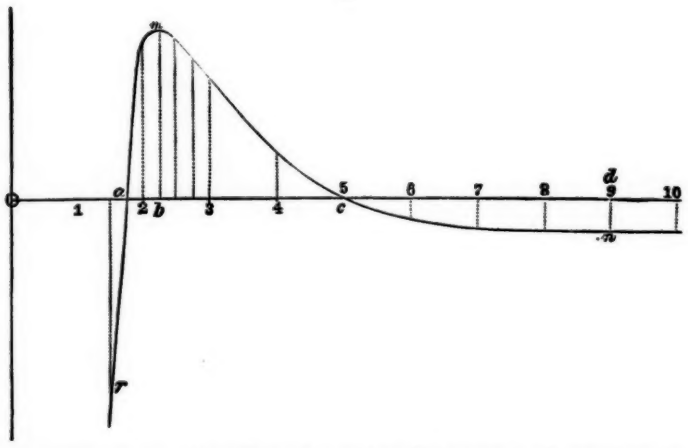
$$f=\frac{n(3r^2+2rx)}{(r+x)^2(2r+x)^2}-\frac{m}{x^2}$$

In this expression n denotes the coefficient of the attractive force, and also of that termed the heat-repulsion, m the coefficient of the electric repulsion, and r the distance between the two centers from which the resultant systems of waves proceed (fig. 3). The molecules of different substances may differ in respect to the values of m and r, and of the ratio $\frac{n}{m}$. Various supposed values of $\frac{n}{m}$ were taken, and the effective molecular action calculated in terms of $\frac{m}{r^2}$. The general character of the results was graphically represented by a *curve of effective molecular action* (fig. 4).

VIII. *Special Results.*—The following are some of the most important *results of the discussion;* a few of which have been obtained since the publication of my former paper.

1. There are two alternations in the nature of the effective molecular action, viz., one from a repulsion at the most minute

4.



distances to an attraction at greater distances, and another to a repulsion beginning at the outer limit of the attraction, and extending to an indefinite distance. This is shown in the figure, in which the distances laid off from *O* represent the assumed values of the distance, x, between the theoretical envelopes, in terms of r, and the ordinates the effective action; a and c are the points at which the alternations occur. At the distance *Ob* the maximum attractive action occurs, and at *Od* the maximum repulsive action. a is the position of stable equilibrium; that is, *Oa* is the distance between the molecular envelopes when the two molecules are in equilibrium under their natural action.

2. For some distance above and below a the curve is very nearly a right line, showing that the effective actions are for small displacements very nearly proportional to the distance from the point of rest. It is to be observed that r, the thickness of the theoretical envelope, is doubtless very small in comparison with the radius of the outer surface of this envelope, and hence that any displacement a^2 is a much smaller fraction of the distance between the centers of the molecules than of the distance *Oa* between the envelopes.

3. The calculations were made for various values of $\frac{n}{m}$, from 4·938 to 12·410. The former value gives a curve lying entirely below the axis of x, and touching it at the distance

2·85 r. For this and every less value of $\frac{n}{m}$ the effective action is repulsive at all distances between the molecules. In proportion as the value of $\frac{n}{m}$ is greater than 4·938, the maximum attraction, bm, is greater, the range ac of attractive action greater, the distance Oa smaller, and the distance Od greater. Oa ranges from $2{\cdot}85r$ to $0{\cdot}5r$; ac from 0 to $19{\cdot}5r$, and Od from $7r$ to $30r$. The value of ab is nearly $0{\cdot}5r$, for all the values of $\frac{n}{m}$ considered, excepting those differing but little from 4·938. The value of the maximum attractive ordinate, bm, varies from 0 to $0{\cdot}73\frac{m}{r^2}$; and that of the maximum repulsive ordinate, dn, from $0{\cdot}0042\frac{m}{r^2}$ to $0{\cdot}00032\frac{m}{r^2}$; the latter value of dn answering to the greatest assumed value of $\frac{n}{m}$. At the distance $80r$ the repulsion becomes very nearly the same for all the assumed values of $\frac{n}{m}$; viz, $0{\cdot}00013\frac{m}{r^2}$.

(To be concluded.)

ART. XLIV.—*A New Sensitive Singing Flame;* by W. E. GEYER, of the Stevens Institute of Technology.

PHILIP BARRY has recently described* a very sensitive flame produced by placing a piece of ordinary wire-gauze on the ring of a retort stand, about four inches above a Sugg's steatite pin-hole burner, and lighting the gas above the gauze. "The flame is a slender cone about four inches high, the upper portion giving a bright yellow light, the base being a non-luminous blue flame. At the least noise this flame roars, sinking down to the surface of the gauze, becoming at the same time almost invisible. It is very active in its responses, and being rather a noisy flame, its sympathy is apparent to the ear as well as to the eye."

A simple addition to this apparatus has given me a flame, which, by slight regulation, may be made either: (1) a sensitive flame merely; that is, a flame which is depressed and rendered non-luminous by external noises, but which does not sing; (2) a continuously singing flame, not disturbed by outward

* Nature, v, 30, Nov. 2, 1871. [This form of apparatus would seem not to be original with Mr. Barry, since identically the same thing, apparently, was described months earlier by Professor Govi, of Turin, and noticed in the September number of the *Moniteur Scientifique*.—EDS.]

noises; (3) a sensitive flame, which only sounds while disturbed; or (4) a flame that sings continuously except when agitated by external sounds. The last two results, so far as known to me, are novel.

To produce them it is only necessary to cover Barry's flame with a moderately large tube, resting it loosely on the gauze. A luminous flame six to eight inches long is thus obtained, which is very sensitive, especially to high and sharp sounds. If now the gauze and tube be raised, the flame gradually shortens and appears less luminous, until at last it becomes violently agitated, and sings with a loud uniform tone, which may be maintained for any length of time. Under these conditions, external sounds have no effect upon it. The sensitive musical flame is produced by lowering the gauze, until the singing just ceases. It is in this position that the flame is most remarkable. At the slightest sharp sound, it instantly sings, continuing to do so as long as the disturbing cause exists, but stopping at once with it. So quick are the responses, that by rapping the time of a tune, or whistling or playing it, provided the tones are high enough, the flame faithfully sounds at every note. By slightly raising or lowering the jet, the flame can be made less or more sensitive, so that a hiss in any part of the room, the rattling of keys, even in the pocket, turning on the water at the hydrant, folding up a piece of paper, or even moving the hand over the table, will excite the sound. On pronouncing the word "sensitive," it sings twice; and in general, it will interrupt the speaker at almost every "s" or other hissing sound.

The several parts of the apparatus need not be particularly refined. By the kindness of Pres. Morton, I have used several sensitive jets of the ordinary kind made of brass; they all give excellent results. Glass tubes, however, drawn out until the internal diameter is between one sixteenth and one thirty-second of an inch, will do almost equally well. For producing merely the singing flame, even the inner jet of a good Bunsen burner will answer. The kind of gauze too is not important: I have generally used a piece which had been rounded for heating flasks; it contained about 28 meshes to the inch.

The tube chiefly determines the pitch of the note, shorter or longer ones producing, of course, higher or lower tones respectively. I have most frequently used either a glass tube twelve inches long and one and a quarter inches in diameter, or a brass one of the same dimensions. Out of several rough pieces of common gas-pipe, no one failed to give a more or less agreeable sound. Among these gas-pipes was one as short as seven inches, with a diameter of one inch; while another was two feet long, and one and a quarter inches in diameter. A third

gas-pipe, fifteen inches long and three quarters of an inch in diameter, gave, when set for a continuous sound, quite a low and mellow tone. If the jet be moved slightly aside, so that the flame just grazes the side of the tube, a note somewhat lower than the fundamental one of the tube is produced. This sound is stopped by external noises, but it goes on again when left undisturbed. All these experiments can be made under the ordinary pressure of street gas, three-fourths of an inch of water being sufficient.

Hoboken, March 18, 1872.

ART. XLV. — *Contributions from the Physical Laboratory of Harvard College.*— I. *On the Electro-motive action of Liquids separated by Membranes;* by JOHN TROWBRIDGE.

IT is well known that two liquids, of a dissimilar chemical composition, separated by a porous partition, give rise to a galvanic current. This fact has an important bearing upon the subject of animal electricity. Desiring to prove certain theories in regard to muscular currents, I undertook the following line of investigation.

The apparatus which I used was identical with that described by DuBois Reymond in his researches upon the muscular currents (Untersuchungen über Thierische Elektricität, Bd. I. p. 213, et seq. Beschreibung, &c.) It consists essentially of the following parts: a sensitive galvanometer with mirror and scale; two vessels filled with a saturated solution of sulphate of zinc, in which the amalgamated zinc terminals of the galvanometer are immersed; and connecting pads formed of many layers of fine filtering paper, which are laid over the edges of the vessels, forming the cushions upon which the muscle or nerve rests.

This apparatus obviates the difficulties arising from the unequal chemical composition of the two electrodes which essentially vitiates conclusions drawn from the currents obtained by touching the muscle or nerve with the bare terminals of the galvanometer.

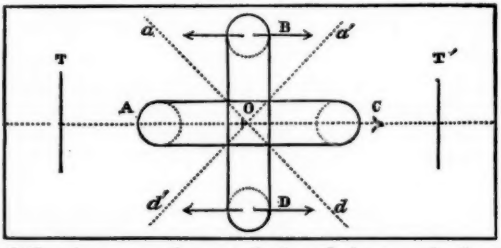
The muscle or nerve is further protected from the saline solution in which the filtering paper is saturated by clay guards or by pieces of bladder soaked in the white of an egg.

In place of the muscle, I made use of a series of artificial muscles, consisting of glass tubes with the openings protected by porous partitions, and filled with the following liquids: undistilled water; weak solution of salt in distilled water; solution of various salts of iron; blood; acidulated water. Having carefully placed the artificial muscle in position with

the proper openings placed upon the protecting guards, I found that each liquid produced a deflection of the needle of the galvanometer. The currents undoubtedly arose from the action of the liquids in the tubes upon the saline solutions with which the cushions and the protecting guards were saturated; for upon filling the artificial muscle with distilled water, no appreciable deflection was produced, whereas when it was filled with a solution of ordinary salt, or with the other liquids mentioned above, a decided swing of the needle resulted, throwing in many cases the spot of light reflected from the mirror of the galvanometer off the scale. The same precautions must be adopted as are advised by the electro-physiologists in obtaining the muscular currents. It will be seen that when we experiment with the muscle itself, we have a vessel containing fresh blood, with all its chemical properties active, separated by the sheath of the muscle from the clay guards placed upon the cushions of the galvanometer. An action must take place between the fluids of the muscle and the saline solutions of the connecting apparatus, which is extremly difficult to distinguish from the muscular current, when we consider that the fluids in their natural state in the muscle must exert a more definite chemical action than when they are removed and put in an artificial test muscle.

When membranes are used instead of clay partitions, endosmotic action may arise. Graham has shown, however, that the membrane must be chemically affected by the separated liquids in order that an appreciable action may take place. This source of error can be shunned by using unbaked sculptor's clay kneaded in sulphate of zinc. We cannot affirm conclusively, however, even in this case, that the membranous sheath of the muscle is not acted upon by the blood and the sulphate of zinc in the clay partition.

1.



In the following experiments I placed the terminals of the galvanometer in an oblong vessel filled with sulphate of zinc; and filling a U tube with the liquid to be experimented with, I closed the ends with pieces of bladder prepared with the white of an egg, and dipped them in the bath of sulphate of zinc.

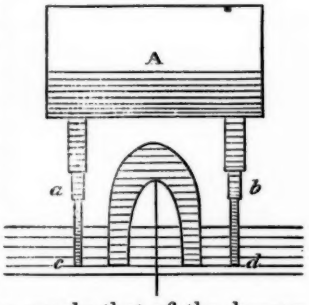
In fig. (1) T and T′ represent terminals of the galvanometer in plan. I found that when the extremities of the U tube were placed along the line A C, a current went from C to A through the U tube, arising probably from the resultant electromotive action at A and C, between the fluid enclosed in the tube and the sulphate of zinc in the connecting vessel. The current passed through the U tube, not, as it might be supposed, flowing merely from the point C to the point A along the surface of the bath. This was shown by contracting the bend of the tube; the deflection of the needle being greatly lessened thereby. Upon turning the U tube around a vertical axis passing through O into the position B D, the needle of the galvanometer returned to zero, and oscillated over a few degrees. This may be explained by supposing that the current divides at B into nearly equal portions, one part taking the direction to the right and the other to the left, and counteracting each other in their action upon the galvanometer. On turning the tube into the position a′ d′, the current is immediately reversed, the current which before passed in the direction O A through the galvanometer, now passing in the direction O C. The same phenomena are repeated at D, when the tube has been turned 270° from the point A; the current running again in the direction O A on a very slight movement of the tube from D toward A.

Care must be taken to eliminate the errors which arise from the mere disturbance of the bath of sulphate of zinc by the introduction of the tube. A rise of level of the bath is sufficient of itself to produce a current, owing probably to an immersion of a fresh portion of the surfaces of the zinc electrodes. This current, however, can be readily distinguished from that arising from the electromotive action between two fluids.

The experiments of Tomlinson on the cohesive figures produced by different liquids readily occurs to one in making these experiments. But there is not a close analogy between the two classes of phenomena; for, upon touching the surface of the bath with a drop of colored liquid, the needle in most cases is deflected before the colored fluid reaches the terminals. These experiments bear upon certain facts stated by writers on electro-physiology. DuBois Reymond having connected the vessels containing the terminals of the galvanometer by a siphon tube containing the same liquid as was contained in the separate vessels, the ends of the tube having been covered with a porous preparation, placed a fore-finger in each vessel near the opening of the connecting siphon tube. Upon contracting one arm violently, he found that the needle was deflected in one direction, and upon contracting the other, the direction was reversed. This action is attributed by DuBois Reymond to

the electrical currents supposed to be circulating in the arms. By the contraction of one arm the muscular current becomes enfeebled, and the current of the other arm predominates. It occurred to me that experiments with the U tube might throw some light upon this celebrated experiment. I therefore arranged the vessels in the manner of Du Bois Reymond, but used instead of the human fingers, a vessel (fig. 2) with two limbs, which were connected with each other at the top. At *a* and *b* are pieces of flexible tubing, and the extremities *c* and *d* were covered with prepared membrane; A was filled with a weak solution of salt.

2.



The resistance of the circuit was nearly that of the human body from the forefinger of one hand to that of the next, and equal to seven or eight times that of the Atlantic cable. The extremities of the tube were then immersed in the liquid of the connecting vessels, the same precautions being observed as are advised by DuBois Reymond. Upon the first contact with the liquid, the spot of light from the galvanometer was deflected over 200 divisions of the scale, and upon the reversal of the limbs the direction of the deflection was also changed. By pinching the flexible tube of one of the limbs, this deflection could be greatly lessened.

When a slight chemical difference was made between the liquids in the two limbs of the tube, and one limb was tightly contracted, a deflection of the needle resulted in a contrary direction from its first indication. This experiment may perhaps be regarded as a mere exemplification of the manner in which the supposed electrical currents circulating in the arms act when the muscles of one arm are violently contracted.

The difficulty, however, in conceiving of a distinct electrical current existing in the arms, and coëxistent with the individual currents claimed by the electro-physiologists; and the further difficulty of conceiving how muscular contraction can effect this current, lead me to believe that the deflection of the needle resulting from the contraction of the muscle of the arms is produced either by the perspiration or by the change in the flow of the blood. It may be mentioned in this connection that the electromotive force between arterial and venous blood is 2.43, if we represent that of a Daniell's cell by 76·42.

(Scoutetten. *Experiences nouvelles pour constater l'electricite*

du sang et en mesurer la force electromotrice. C. R., lvii, 791–795.)

It is well known that muscular contractions can alter the character of the blood; and we have shown that a very slight chemical difference between .two fluids separated by a membrane of the same nature as the cutaneous covering of the fingers, will be shown by the galvanometer.

II.—*Demagnetization of Electro-magnets;* by ROBERT W. WILLSON, Junior Class, Harv. Coll.

Wiedemann has shown Pogg. Ann. C. 235, Ann. de Min. (3), l, 189, that the intensity of the current necessary to demagnetize a steel magnet is much less than that of the current by which the bar was originally magnetized.

It has occurred to me to experiment, with a view to ascertaining how far this principle can be applied to electro-magnets.

The apparatus used consisted of a cylindrical bar of soft iron 8 c.m. in length and 1 c.m. in diameter, slightly rounded at the end. The armature was a piece of soft iron, of the same diameter and 2 c.m. in length.

Around this core were placed two concentric helices, wound in opposite directions, through each of which could be passed the current of a single Grove's cell.

The method of experimenting was as follows. A current was first passed through the inner helix, which, for convenience, I shall call A, and the weight supported by the bar was noted. This current being broken, the outer helix, B, was introduced into the circuit, and the corresponding weight noted. The current through B being then broken, and that through A closed, after a short time, the current was again passed through B and the weight noted. The following table shows the results.

Wt. supported by— A	B	A diminished by B
490 grms.	250	130
470	240	130
460	230	130
460	220	120
420	220	130
410	200	110
Mean 452	227	125

Taking the mean result, we see that while the helix B can only develop sufficient magnetism in the bar to render it capable of sustaining 227 gr., yet, if it act in opposition to A, it can diminish the weight which the latter supports by 327 grms.; that is, its power to demagnetize is greater than its power to magnetize.

If then we suppose the coercive force of the steel bar used in Wiedemann's experiments to be represented by the helix A, and the demagnetizing current of feeble intensity to be represented by the helix B, of less magnetizing power, we have here an interesting confirmation of Wiedemann's results, while we may also extend the application of the principle to electro-magnets, and may assert, in general, that a current of given intensity, or a helix of given dimensions, traversed by a constant current, has greater power to demagnetize than to magnetize. It is evident that the case of demagnetizing an electro-magnet by a current is more difficult than the process of demagnetizing a steel bar; for whereas in a steel magnet the resistance is simply the coercive force of the steel, so that the bar when partially deprived of its magnetism has no tendency to return to its original state, even if the demagnetizing current be broken, in the case of electro-magnets the helix, by which the bar was originally magnetized, is still acting with its full power when the demagnetizing helix in introduced into the circuit.

A natural inquiry was this: if the bar were magnetized by the weaker helix B, and then demagnetized by the helix A, what additional amount of magnetism could A impart to the bar? It is evident that this case, though somewhat similar to the former, is not identical with it; here the helix B acts as resistance to the magnetization of the bar, while in the former case it acted to deprive the bar of a portion of the magnetism which it already possessed.

Accordingly the bar, being magnetized by B, was submitted to the action of A, and the weight supported being noted, the reverse operation was performed, and the weights supported compared as follows:

A demagnetized by B.	B demagnetized by A.
85	65
70	65
65	60
65	50

It will be noticed that the results in the left hand are larger than those in the right hand column, that is, when A is simply demagnetized by B, it can support a greater weight than when it is employed to magnetize the bar against the resistance of B.

In short, the result of my experiments has been to show that a given helix, traversed by a given current, has more power to demagnetize than to magnetize, while its power to prevent magnetization is greater than either.

ART. XLVI.—*Canons of Systematic Nomenclature for the higher groups;* by SAMUEL H. SCUDDER.

SEVERAL years ago, the American Association for the Advancement of Science appointed a committee to reconsider the canons of biological nomenclature, and to report whether, with the growth of science, they required any additions or alterations. No report has yet been made, nor, so far as we are aware, is any likely to be presented, until the subject is again brought prominently forward and new instructions given. Professor A. E. Verrill has since republished * the Revised Rules of Zoölogical Nomenclature adopted by the British Association for the Advancement of Science in 1865, and has accompanied them by a few apt comments; in England, Mr. W. F. Kirby, in a paper read before the Linnean Society of London, has called attention to the extensive changes which a strict adherence to the laws of priority would cause in the generic nomenclature of butterflies; and quite recently has put the same into practice in his catalogue of these insects.

But hitherto very little has been said concerning the special application of definite rules to groups higher than genera, and it is to this division of the subject that we desire to call attention.

In attempting to legislate upon this branch of zoölogical nomenclature, two principles must be kept in view: *first*, so far as possible, the canons already in general acceptance for generic nomenclature should be applied to all the monomial groups. Unity of principle lies at the foundation of acceptable legislation; *second*, retrospective laws should be avoided.

One difficulty meets us at the outset,— what some are pleased to term the unstable nature of the higher groups, but which we should prefer to call the disagreement of naturalists as to the limits and value of these groups; yet as this diversity of view is a nearly equal hindrance to any code of rules, it needs only to be mentioned in passing.

Endeavoring to keep in mind the principles above enunciated, and as the simplest means of presenting our views, the following outline of a code is suggested for the consideration of zoölogists.

Canons.—I. The name originally given by the founder of a group should be permanently retained, to the exclusion of all subsequent synonyms.

This rule, recognizing the law of priority, which lies at the foundation of all systematic nomenclature, is the same as the

* This Journal, July, 1869.

first and prime rule of the code accepted by the British Association, with the exception of certain references made exclusively to species; and, since this canon meets universal acceptance, there is no need of discussing it, aside from the following limitations.

1. This law of priority should not extend to works published before 1758.

The same reasons for such a limitation do not exist in the present instance as in the case of specific nomenclature; but similar objections can be made to an earlier limitation. Only three reasonable courses are open to the naturalist: to accept (*a*) no limitation whatever, in which case "our zoölogical studies would be frittered away amid the refinements of classical learning; (*b*) the limitation here formulated, in which case all our systematic nomenclature takes its common origin in the tenth edition of Linné's Systema Naturæ;* or (*c*) to apply the laws of nomenclature to each kind of group (subfamily, family, class, etc.), from the time when such group was first brought into use—which would engender such confusion as speedily to bring all nomenclature into deserved disrepute.

2. Plural or collective substantives (or adjectives used as substantives) are alone admissible.

As the higher groups are all collective—in idea, if not in fact—it is essential that the names applied to them should be at least capable of a collective sense; and names which are not so formed should be dropped. The retrospective action of such a law would be very slight.

3. A name which has been previously proposed for some genus or higher group in zoölogy should be expunged.

This accords too well with accepted rules to require any discussion.

4. When two authors define and name (differently) the same group, both making it of the same or very nearly the same extent, the later name (or if synchronous, the least known name) should be cancelled, and never again brought into use.

With the exception of certain verbal modifications, this law is identical with the sixth section of the British Association rules, where it is applied to genera only.

5. In any subsequent alterations of the limits of a group, its name should never be cancelled; but should be retained either in a restricted or an enlarged sense.

The necessity for such a limitation is obvious; otherwise a different name would (or, could) be given by every author who

* The English—the strongest upholders of the plan of dating from the twelfth edition of the Systema Naturæ—are now, by degrees, accepting the earlier date of 1758 as the starting point for zoölogical nomenclature, and we may assume that, in this view, the whole scientific world will sooner or later concur.

differed from preceding ones in his ideas of the precise limitation of any group in question. This indeed has already been done, and, if continued, will create lamentable confusion; but this limitation should itself be subject to one exception, which may be formulated thus:

6. But any assemblage so defined by an author as harshly to violate the groupings of nature (as known to naturalists of his time), should be cancelled.

Such a rule would prevent the injury which might accrue to science by too close an application of the preceding law. The parenthetical limitation seems, however, to be necessary.

II. Changes in the name of one group should not affect the names of other groups.

This follows as a corollary of the first canon, but it has been not infrequently violated, and it is easy to perceive the cause. The nomenclature of higher groups, notably of families and subfamilies, has, to a considerable degree, been founded upon generic names, with the addition of special collective endings to the root (see recommendation 1). Now, when a generic name which has formed the basis of a family designation has been found to be pre-occupied, it has been thought necessary by some to recast the nomenclature of the higher group. But why? After a name has been long applied to a group, it ceases to have any intrinsic meaning, and is simply associated with the group itself, recalling it without reference to any particular member of the same. It certainly would be agreeable if we had a nomenclature in which each group should by the very association of ideas recall its members; but since that is utterly impossible, and we have to deal with a mass of synonyms already tangled and intricate, our problem is—how best to make our way out of the difficulty without a continual wrangling over names and entailing endless disputes upon future generations.

To this canon no exception whatever should be made; for it would be difficult to draw the line anywhere and gain general consent. Anyone who considers the subject, will see that one apparently reasonable exception will lead to another scarcely less desirable, until the whole value and force of the proposed canon is destroyed.

III. The mere enumeration of its members, when known, is a sufficient definition of the limits of a group, and gives it an unquestionable claim to recognition.

Although it is certainly *most* desirable that every name proposed for a group should, when first propounded (or shortly after), be accompanied by a full description of its essential characters, it is evident that no one acquainted with the subject of which an author treats can fail to understand his meaning if he defines his groups by mere enumeration of their members. If

for instance, he designates the known genera to be embraced in a proposed family, he actually defines his group much better than he could do by a specification of its characters, since we have probably not yet been favored with any description of a natural family which gives everything which is characteristic and omits all that is not.

Recommendations.—1. "That assemblages of genera, termed families, should be uniformly named by adding the termination -idæ to the name of the earliest known or most typically characterized genus in them; and that their subdivision, termed subfamilies, should be similarly constructed with the termination -inæ."

This recommendation, formulated by the committee of the British Association, is deprived of a great part of its value by the disagreement of naturalists as to the nature of family and subfamily groups,—assemblages of very diverse natures having received this designation at the hands of different writers; indeed, up to the issue of Professor Agassiz's Essay on Classification, no one had ever attempted to give definite shape to current opinions upon the subject; and it will be long before we shall see a general concurrence in either the views put forward in that work, or in any modification of them. Such being the case, it is evident that this recommendation cannot have the force of a law, nor be allowed any retrospective action. Otherwise these rules, or any other reasonable ones (however generally they may be accepted), are powerless to assign to any higher natural group a fixed and unalterable name; but the group in question would receive a different name from different authors, according as they considered it a subfamily or an assemblage of still another nature.

2. All monomial collective names should be derived from the Greek, and have a plural form.

3. Only the surname of the author who first proposed a group need follow its name, whether the group be used in its original or in a modified sense; but when it is desirable to indicate at the same time its recognized, altered limits, the surname of the writer who first proposed the accepted circumscription may follow in a parenthesis.

In systematic nomenclature, the object is to register titles, not to gratify pride, and the names of authors are appended for convenience, not fame; the question of justice or injustice has no place here; and yet the above recommendation ought to be satisfactory to those who view this matter in a different light.

ART. XLVII.—*On some new Species of Paleozoic Fossils;** by E. BILLINGS, F.G.S.

Genus HYOLITHES *Eichwald.*

In the following description of new species of *Hyolithes*, I shall call the side of the fossil which is most flattened, or from which there is a projection in front of the aperture, "the ventral side." Directly opposite is the "dorsum." The lateral walls, whether consisting of two sloping planes, as in fig. 2, or rounded as in the other figures, I shall designate simply "the sides." The "width" of the aperture is the greatest distance between the two most projecting points of the sides. This is

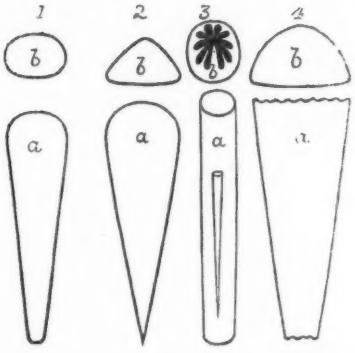


Fig. 1. *Hyolithes communis.* 2. *H. Americanus.* 3. *H.? micans.* 4. *H. princeps.* In these diagrams *a* represents the rate of tapering of the shell on the ventral side; *b*, the transverse section (except in 3 *b*, which is the inner surface of an operculum enlarged two diameters). The small figure in 3 *a* represents the apical portion of a specimen. N. B.—All these species vary slightly in the rate of tapering.

sometimes close to the ventral side, as in fig. 2. The "depth" is the distance between the median line of the ventral side and the dorsum, and is at right angles to the width. That part of the ventral side which projects beyond the aperture is the "lower lip." The "ventral limb" of the operculum is that side which is in contact with the lower lip, when the operculum is in place, in the aperture. The "dorsal limb" is the opposite side of the operculum, in contact with the dorsum. In some of the opercula there is a point around which the surface markings are arranged concentrically; this is the "nucleus."

The following species occur in the pebbles and boulders of a

* Extracted from the Canadian Naturalist of December, 1871.

conglomerate which constitutes an important formation on the south shore of the St. Lawrence, below Quebec. The age of the rock in which these pebbles are found, is not yet certainly determined, but it is, at all events, near that of the Potsdam.

H. communis.—This species attains a length of about eighteen lines, although the majority of the specimens are from ten to fifteen lines in length. The ventral side is flat (or only slightly convex) for about two-thirds the width, and then rounded up to the sides. The latter are uniformly convex. The dorsum, although depressed convex, is never distinctly flattened, as is the ventral side. The lower lip projects forward for a distance equal to about one-fourth or one-third the depth of the shell. In a specimen whose width is three lines, the depth is two lines and a half.

The operculum is nearly circular, gently but irregularly convex externally, and concave within. The ventral limb is seen on the outside as an obscurely triangular, slightly elevated space, the apex of the triangle being situated nearly in the center of the operculum. The base of the triangle forms the ventral margin. This limb occupies about one-third of the whole superficies of the external surface. The remainder, constituting the dorsal limb, is nearly flat, slightly elevated from the margin toward the center. On each side of the apex of the ventral limb there is a slight depression, running from the nucleus out to the edge. On the inside there is an obscure ridge, corresponding to each one of the external depressions. It is most prominent where it reaches the edge. These two ridges meet at the center, and divide the whole of the inner surface of the operculum into two nearly equal portions.

The surface of the operculum is concentrically striated. The shell itself in some of the specimens is covered with fine longitudinal striæ, from five to ten in the width of a line. The shell varies in thickness in different individuals. In some it is thin and composed of a single layer, but in others it is much thickened by concentric laminæ, and thus approaches the structure of a *Salterella*. There are also fine engirdling striæ, and sometimes obscure sub-imbricating rings of growth.

This species has been found at Bic and St. Simon.

Fig. 1 *b*, representing the transverse section, is not so distinctly flattened on the ventral side as it is in most specimens.

Collected by T. C. Weston.

H. Americanus.—Length from twelve to eighteen lines, tapering at the rate of about four lines to the inch. Section triangular, the three sides flat, slightly convex or slightly concave, the dorsal and lateral edges either quite sharp or acutely rounded. Lower lip rounded, projecting about two lines in full-

grown individuals. Surface finely striated, the striæ curving forward on the ventral sides, and passing upward on the sides at nearly a right angle, curve slightly backward on the dorsum. In a specimen eighteen lines in length, the width of the aperture is about six lines and the depth about four, the proportions being slightly variable.

The operculum has a very well-defined conical ventral limb, the apex of which is situated above the center, or nearer the dorsal than the ventral side. The dorsal limb forms a flat margin, and is so situated that when the operculum is in place, the plane of this flat border must be nearly at right angles to the longitudinal axis of the shell. In an operculum six lines wide, the height of the lower limb to the apex of the cone is two and a half lines, and the width of the flat border, which constitutes the dorsal limb, about one line.

This species occurs at Bic and St. Simon; also at Troy, N. Y., where it has been found abundantly by Mr. S. W. Ford of that city. It is *Theca triangularis* of Hall, Pal. N. Y., vol. i., p. 213, 1847. As that name was preoccupied by a species previously described by Col. Portlock, Geol. Rep. on Londonderry, p. 375, pl. 28 A, figs. 3*a*, 3*b*, 3*c*, 1843, it must be changed. It is a very abundant species, and varies a good deal.

The Canadian specimens were collected by T. C. Weston.

H. micans.—This is a long, slender, cylindrical species, with a nearly circular section. The rate of tapering is so small, that it amounts to scarcely half a line in length of eighteen lines, where the width of the tube is from one to two lines. The largest specimen collected is two and a half lines wide at the larger extremity, and if perfect would be four or five inches in length.

The operculum does not show distinctly a division into a dorsal and ventral limb. It is of an ovate form, depth somewhat greater than the width, the nucleus about one-third the depth from the dorsal margin. Externally it is gently concave in the ventral two-thirds of the surface; a space around the nucleus is convex, and finely striated concentrically. On the inner surface there is a small pit at the dorsal third of the depth, indicating the position of the nucleus. From this point radiate ten elongate ovate scars, arranged in the form of a star, the rays toward the ventral side being the longest. None of these scars quite reach the margin.

The shell and operculum are thin and of a finely lamellar structure, smooth and shining.

Occurs at Bic and St. Simon; also at Troy, N. Y.

Collectors, T. C. Weston and S. W. Ford.

Sometimes numerous small specimens, from half a line to three lines in length, are found with the operculum on the same slab.

This shell appears to me at present to constitute a new genus,

differing from the majority of the species of *Hyolithes* in its circular section, the operculum not divided into dorsal and ventral limbs, and in the remarkable system of muscular impressions on the interior. Barrande has figured an operculum of the same type, differing from this in having only three instead of five pairs of impressions. They are, however, arranged on the same plan in both the Canadian and Bohemian species.* It is possible that our species may be a *Salterella.*

H. princeps.—Shell large, sometimes attaining a length of three or four inches, tapering at the rate of about three lines to the inch. In perfectly symmetrical specimens, the transverse section is nearly a semicircle, the ventral side being almost flat, usually with a slight convexity, and the sides and the dorsum uniformly rounded. In many of the individuals, however, one side is more abruptly rounded than the other, in consequence of which the median line of the dorsum is not directly over that of the ventral side, and the specimen seems distorted. This is not the result of pressure, but is the original form of the shell. Sometimes, also, there is a rounded groove along the median line of the dorsum. The latter is somewhat more narrowly rounded than the sides. Lower lip uniformly convex, and projecting about three lines in a large specimen. Surface with fine striæ and small sub-imbricating ridges of growth. These curve forward on the ventral side. In passing upward on the sides, they at first slope backward from the ventral edge, and then turn upward and pass over the dorsum at a right angle to the length.

When the width of the aperture is seven lines, the depth is about five. The operculum has not been identified.

Collected by T. C. Weston at Bic and St. Simon.

Genus OBOLELLA *Billings.*

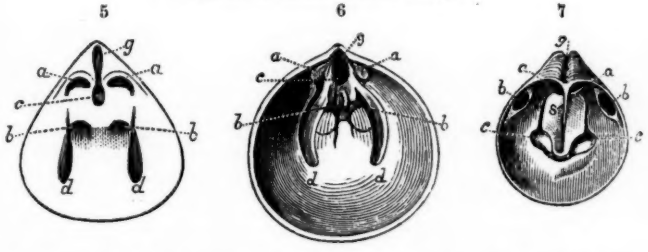


Fig. 5. Interior of the ventral valve of *O. gemma,* enlarged about five diameters. *aa,* the two small scars at the hinge; *bb,* the two central scars; *c,* the small pit near the hinge; *dd,* the two principal muscular scars; *g,* the groove in the area.

6. Interior of the ventral valve of *O. desquamata* Hall,† enlarged 2½ diameters.

7. Interior of the ventral valve of *Obolus Apollinis* Eichwald, copied from Davidson's "Introduction to the study of the fossil Brachiopoda."

* Systéme Silurian, &c., vol. iii, pl. 9, fig. 16 H, and fig. 17.

† Engraved from a figure kindly drawn for me by Thos. Davidson, Esq., F.R.S., of Brighton, England. The specimen is from the original locality of the species, Troy, N. Y. Collected by T. C. Weston.

Generic Characters.—Shell unarticulated, ovate or sub-orbicular, lenticular, smooth, concentrically or radiately striated, sometimes reticulated by both radiate and concentric striæ. Ventral valve with a solid beak and a small more or less distinctly grooved area. In the interior of the ventral valve there are two elongated sub-linear or petaloid muscular impressions, which extend from near the hinge line forward, sometimes to points in front of the mid-length of the shell. These are either straight or curved, parallel with each other or diverging toward the front. Between these, about the middle of the shell, is a pair of small impressions, and close to the hinge line a third pair, likewise small, and often indistinct. There is also, at least in some species, a small pit near the hinge line, into which the groove of the area seems to terminate. In the dorsal valve there are six impressions corresponding to those of the ventral valve, and sometimes an obscure rounded ridge along the median line.

If we compare the interior of the ventral valve of an *Obolella* with that of *Obolus Apollinis*, we see that there are six muscular impressions in each, but not arranged in the same manner. The two small scars *aa*, at the hinge line, are most probably the same in both genera. The two lateral scars *bb* of *Obolus* have no homologue in *Obolella*, unless they be represented by the two large ones *dd*. Should this be the case, however, the great difference in their position would no doubt be of generic value. I think it more probable that the large scars *dd* of *Obolella* represent the central pair *cc* of *Obolus*. Again, Eichwald says that in the interior of the ventral valve of *O. Apollinis* there is a longitudinal septum (shown in the above fig. 7 at *s*), which separates the two adductors *cc*, and extends to the cardinal groove (I suppose he means the groove *g* on the area).* No such septum occurs in any species of *Obolella*. I have not seen any description of the dorsal valve of the *O. Apollinis* sufficiently perfect to afford a means of comparison with that of *Obolella*, but the differences in the ventral valve alone are so great that the two genera can scarcely be identical. They are, however, closely related, and occur in nearly the same geological horizon.

In the rocks below Quebec and at the Straits of Belle Isle, we find the following species of *Obolella*:—

1. *O. desquamata* Hall, = *Avicula? desquamata*, Pal. N. Y., vol. i, p. 292, pl. 80, fig. 2. Occurs at Troy, N. Y.

2. *O. crassa* Hall, = *Orbicula? crassa*, op. cit. p. 299, pl. 79, fig. 8. Occurs at Troy.

* Speaking of the adductors, he says: "Une crête longitudinal occupe le milieu des dernières impressions et arrive jusqu'au sillon cardinal." (Lethea Rossica, vol. i, p. 925).

3. *O. cœlata* Hall, = *Orbicula cœlata*, op. cit. p. 290, pl. 79, fig. 9. Occurs at Troy.

4. *O. gemma*, n. sp.

5. *O. circe*, n. sp.

6. *O. chromatica* Billings; has been found as yet only at the Straits of Belle Isle.

The following are new species:

O. gemma.—Shell very small, about two or three lines in length, ovate, both valves moderately convex and nearly smooth. Ventral valve ovate, the anterior margin broadly rounded, with sometimes a portion in the middle nearly straight; greatest width at about one-third the length from the front, thence tapering with gently convex or nearly straight sides to the beak, which is acutely rounded. The area is about one-fifth or one-sixth the whole length of the shell, with a comparatively deep groove, which extends to the apex of the beak. The dorsal valve is nearly circular, obscurely angular at the beak, and rather more broadly rounded at the front margin than at the sides.

In the interior of the ventral valve there are two small muscular impressions of a lunate form, close to the cardinal margin, one on each side of the median line. A second pair consists of two elongate sub-linear scars, which extend from the posterior third of the length of the shell to points situated at about one-fourth the length from the front margin. These scars are nearly straight, parallel or slightly diverging forward, and divide the shell longitudinally into three nearly equal portions. Between them, about the middle of the shell, are two other small obscurely defined impressions. There is also a small pit close to the hinge line and in the median line of the shell. In the interior of the dorsal valve there is an obscure rounded ridge which runs from the beak along the median line almost to the front margin. Close to the hinge line there is a pair of small scars, one on each side of the ridge. The other impressions in this valve have not been made out.

The surface of both valves is in general nearly smooth, but when well preserved shows some obscure concentric striæ.

This species is closely allied to *O. chromatica*, the species on which the genus was founded, only differing from it, so far as the external characters are concerned, in being much smaller, and the beak of the ventral valve more extended.

Occurs at Bic and St. Simon. Collected by T. C. Weston.

O. circe.—Ovate, front and sides uniformly rounded, posterior extremity more narrowly rounded than the front, length and width about equal, greatest width at the mid-length, rather strongly and uniformly convex, surface nearly smooth, but with fine concentric striæ. Length seven lines, width a little

less. The rostral portion of the shell is much thickened for about one-fifth the length, and in this part there is a deep and wide groove. In front of the thickened portion the muscular impressions are indistinctly seen, but appear to be formed on the same plan as those of the ventral valve of the genus.

The above description is drawn up on one exterior, and several interiors of the same valve, apparently the ventral valve. The exterior is very like that of *O. desquamata*, and is of the same size, but the interior shows it to be an entirely distinct species.

Length of the largest specimen seen, seven lines; width about the same, or slightly less.

Occurs at Trois Pistoles. Collected by T. C. Weston.

Platyceras primævum.—Shell minute, consisting of about two whorls, which as seen from above are ventricose, but most narrowly rounded at the suture: the inner whorl scarcely elevated above the outer. The under side is not seen in the specimen. Diameter, measured from the outer lip across to the opposite side, one line; width of last whorl at the aperture, about one-third of a line.

Collected at Bic by T. C. Weston.

Proposed new genus of Brachiopoda.

Genus MONOMERELLA, gen. nov.

Generic characters.—Shell unarticulated, ovate or orbicular; ventral valve with a large area and with muscular impressions like those of *Trimerella*. Dorsal valve with muscular impressions in the central and posterior portion of the shell, nearly like those of *Obolus*. In the ventral valve there is only a single septum, which extends from the cardinal line a greater or less distance forward. There are two cavities in the shell beneath the area. In the dorsal valve there are no cavities in the shell. The main difference between this genus and *Trimerella* are, thus, as follows:—

Trimerella.—Cavities in both valves.

Monomerella.—Cavities in the ventral valve, but none in the dorsal.

The above description is intended to be merely introductory. As Mr. Davidson will soon fully describe and illustrate the genus from both Canadian and Swedish specimens, no more need be said about it here.

This genus was discovered in the spring of 1871, at Hespelar, Ontario, in the Guelph limestone, by T. C. Weston. Before venturing to describe it, I sent a specimen to Mr. Davidson, and on returning it he stated that he considered it to be a new genus, "very closely allied to *Trimerella*." Lately I received a letter from him in which he states that he has obtained the same genus

from Wisby, Island of Gothland, and he requested me to name it, as he was about to publish the Swedish species.

We have two distinct species, both occurring in the Guelph limestone. This formation I consider to be about the age of the Aymestry limestone of the English geologists. I shall characterize our species briefly as follows. Full descriptions and figures will be given hereafter.

M. prisca.—Ventral valve ovate, greatest width at about the anterior third of the length, thence tapering with gently convex sides to the narrowly rounded beak; front margin broadly rounded; septum about one-third the length of the shell. Dorsal valve about one-fourth shorter than the ventral, and more broadly rounded at the anterior extremity. On a side view the outline of the ventral valve would be, so far as we can judge from a cast of the interior, somewhat straight, or only gently arched from the beak to the front margin. The dorsal valve, on the other hand, is rather strongly convex, most prominent in the anterior half. It is evident that the general cavity of the shell of the dorsal valve extends a short distance under the area.

Length of ventral valve, eighteen lines; greatest width, thirteen or fourteen lines; length of dorsal valve about fourteen lines. There are some fragments in the collection which indicate a larger size.

Occurs in the Guelph limestone at Hespelar, Ontario. Collected by T. C. Weston.

M. orbicularis.—Broadly ovate, nearly circular, lenticular, both valves moderately convex; septum about one-third the length. The casts seem to show that a thin plate extends forward a short distance from the cardinal edge, supported by the septum. The length and width appear to be about twelve or fifteen lines.

Occurs with *M. prisca.* T. C. Weston, collector.

Both *Trimerella* and *Monomerella* are sub-genera of *Obolus.*

There is, beside the above, a third group which differs from the other two in having no cavities in either valve.* It includes the species I have called *Obolus Canadensis* and *O. Galtensis.* For this group I would propose the name OBOLELLINA. It differs from *Obolus Apollinis* in the form of the area of the ventral valve, and in having a small pair of muscular impressions in the dorsal valve, in front of the large central pair. In all

* Since the above was published in the Can. Nat., in Dec. last, I have ascertained that cavities may exist both in *Monomerella* and *Obolellina.* Where they do occur, however, in species of these genera, they are small or rudimentary as compared with their great size in *Trimerella.* They occur in some individuals of *O. Galtensis,* but not in others. When, therefore, they are only slightly developed, they are not even of specific value. But when very large, they may be of subgeneric importance.

three of these sub-genera there are species which have the large muscular impressions of the ventral valve obliquely striated or grooved. This seems to show that the muscles were not single, but composed of several bands. The three genera pass gradually into each other, and yet I think some sort of a subdivision is required. It seems almost absurd to place such shells as *T. grandis* and *O. Canadensis* in the same generic group.

Proposed new genus of Pteropoda.

Genus HYOLITHELLUS, gen. nov.

Since the sheet containing the description of *Hyolithes micans* was printed off, I have arrived at the conclusion that a new genus for its reception should be instituted. I propose to call it *Hyolithellus*. It differs from *Hyolithes*, in its long slender form and in the peculiar structure of its operculum.

Montreal, 23d March, 1872.

ART. XLVIII.—*Preliminary Description of* HESPERORNIS REGALIS, *with Notices of four other new Species of Cretaceous Birds;* by O. C. MARSH.

THE few remains of birds hitherto described from the Cretaceous deposits of this country, although of much interest, all pertained to comparatively small species, and belonged, apparently, to families still existing.* It is fortunate, therefore, that the existence of a fossil bird, so large and remarkable as the one that forms the subject of the present description, should first be made known by the discovery of such important parts of a skeleton, as to afford ample material for the determination of its affinities. This interesting discovery has already been announced in this Journal, and the name, *Hesperornis regalis*, proposed by the writer for the species thus represented.† The present paper is preliminary to a full description, with illustrations, now in course of preparation. The other species briefly described in this article are likewise of interest, as they add some new forms to the limited avian fauna heretofore found in the Cretaceous beds of the Atlantic coast.

Hesperornis regalis, gen. et sp. nov.

The remains of this species at present known consist of portions of one skeleton, including the nearly entire posterior limbs, from the femur to the terminal phalanges, parts of the pelvis, several cervical and caudal vertebræ, and numerous ribs,

* This Journal, vol. xlix, p. 205, March, 1870. † Vol. iii, p. 56, Jan., 1872.

all in excellent preservation. Fragments of four other individuals were also found by the writer, which agree essentially with the corresponding parts of the more perfect skeleton. An examination of these various remains soon makes it evident that they represent a gigantic swimming bird, having its nearest living allies probably in the *Colymbidæ*, but differing widely in many respects from that group, and from all other known birds, recent and extinct.

The femur is unusually short and stout, much flattened antero-posteriorly, and the shaft curved forward. It somewhat resembles in form the femur of *Colymbus torquatus* Brün., but the great trochanter is proportionally much less developed in a fore-and-aft direction, and the shaft is much more flattened. The tibia, or *tibia-tarsus*, is straight and elongated. Its proximal end has a moderately developed cnemial process, with an obtuse apex. The epi-cnemial ridge is prominent, and continued distally about one-half the length of the shaft. The distal end of the tibia has on its anterior face no ossified supratendinal bridge, differing in this respect from all known aquatic birds. The fibula is well developed, and resembles that of the Divers.

The tarso-metatarsal bone is much compressed transversely, and resembles in its main features that of *Colymbus*. On its anterior face there is a deep groove between the third and fourth metatarsal elements, bounded on its outer margin by a prominent rounded ridge, which expands distally into the free articular end of the fourth metatarsal. This extremity projects far beyond the other two, and is double the size of either, thus showing a marked difference from any known recent or fossil birds. There is a shallow groove, also, between the second and third metatarsals, which taken in connection with the deeper one, made the specimen appear, while still in the rock, as if its main elements were separate. The second metatarsal is much shorter than the third or fourth, and its trochlear end resembles in shape and size that of the former. The existence of a hallux is indicated by an elongated oval indentation on the inner margin above the articular face of the second metatarsal. The free extremities of the metatarsals have the same oblique arrangement as in the *Colymbidæ*, to facilitate the forward stroke of the foot through the water. There are no canals or even grooves for tendons on the posterior face of the proximal end, as in the Divers and most other birds; but below this there is broad, shallow depression, extending rather more than half way to the distal extremity.

The phalanges of the large, external toe are very peculiar, although an approach to the same structure is seen in the genus *Podiceps*. On the outer, inferior margin they are all deeply exca-

vated. The first, second and third have, at their distal ends, a single, oblique, articular face on the inner half of the extremity, and the outer portion is produced into an elongated, obtuse process, which fits into a corresponding cavity in the adjoining phalanx. This peculiar articulation prevents flexion except in one direction, and greatly increases the strength of the joints. The terminal phalanx of this toe was much compressed. The third, or middle, toe was greatly inferior to the fourth in size, and had slender, compressed phalanges, which correspond essentially in their main features with those of modern Divers. The phalanges of the first and second toes of the present specimen are wanting.

Portions of the pelvis, found with the posterior limbs in three of the specimens, indicate that the illia were separated from each other, and not very firmly ossified to the sacral vertebræ. The acetabulum was covered with a thick cushion of cartilage, as in *Apteryx*, and, at its upper margin, the anterior and posterior extensions of the illia, if both existed, were disconnected, or unossified at their union.

The cervical and caudal vertebræ preserved present no features deserving of special mention in this preliminary notice. The latter are numerous, but apparently not much in excess of those in some modern birds. Unfortunately, no portions of the skull were recovered. The femur and tibia have very thick, compact walls, and do not appear to have been pneumatic. The tarso-metatarsals and the phalanges were nearly or quite solid.

Measurements.

	mm.
Length of right femur,	98·
Transverse diameter of proximal end,	53·
Diameter of articular head,	18·5
Transverse diameter of shaft, at middle,	22·
Antero-posterior diameter,	19·2
Transverse diameter of distal end,	53·5
Length of right tibia,	316·
Transverse diameter of proximal articulation,	38·
Length of cnemial process,	22·
Transverse diameter of shaft, at middle,	29·
Transverse diameter of distal end,	32·
Antero-posterior extent of outer condyle,	32·
Antero-posterior extent of inner condyle,	22·
Length of right tarso-metatarsal,	137·
Length to distal end of third metatarsal,	130·
Length to distal end of second metatarsal,	116·
Transverse diameter of proximal articulation,	36·
Least transverse diameter of shaft,	15·
Transverse diameter of distal end of fourth metatarsal,	16·
Transverse diameter of third metatarsal,	8·5

Transverse diameter of second metatarsal,	8· mm.
Length of proximal phalanx of fourth toe,	45·
Length of second phalanx,	39·5
Length of third phalanx,	40·
Length of proximal phalanx of third toe,	41·

The various remains of the present species already discovered belonged to five individuals, which differed but little in size, or in any important particulars. Taking the great Northern Diver (*Colymbus torquatus* Brün.) as a standard of comparison for the portions that are wanting, the skeleton of *Hesperornis regalis* would measure about five feet and nine inches from the apex of the bill to the extremities of the toes.

The affinities of *Hesperornis* have already been mentioned. The characters given in the above description show plainly that, although a comprehensive type, it belongs in the Palmipedes; and while most nearly allied to the *Colymbidæ*, it still differs so widely from that group in the structure of the pelvis and posterior limbs as to demand a place in at least a separate family, which may be called *Hesperornidæ*.

All the remains of the species now known were found by the writer, last summer, in the gray shale of the upper Cretaceous, near the Smoky Hill River, in Western Kansas.

Graculavus velox, gen. et sp. nov.

Among the vertebrate remains in the Yale Museum, from the Cretaceous green-sand of New Jersey, are fragments of the skeletons of two aquatic birds, which apparently belong to the same genus, although to quite distinct species. Both of these differ essentially from any recent birds, but are evidently most nearly allied to the Cormorants. The largest of these birds, to which the above specific name may be given, is mainly represented, at present, by the proximal half of a left humerus, in perfect preservation, and hence a very characteristic specimen. In its general features this humerus resembles that of the common Cormorant (*Graculus carbo* Linn.), although indicating a somewhat smaller species. The articular head is much more compressed transversely, its apex is more prominent, and its anconal margin is strongly deflected. The median ridge, on the anconal side below the head, is rounded instead of angular, and the ulnar crest is much less produced distally.

Measurements.

Greatest diameter of proximal end of humerus,	23·75 mm.
Vertical diameter of articular head,	13·
Transverse diameter,	6·
Proximal extension of head beyond ulnar crest,	4·6
Least diameter of shaft below proximal extremity,	6·

The specimens on which this species is based were found by John G. Meirs, Esq., at Hornerstown, New Jersey, in the greensand of the upper Cretaceous, and by him presented to the Museum of Yale College.

Graculavus pumilus, sp. nov.

The present species, which is hardly more than one-third the size of the preceding, is likewise represented by the proximal end of a humerus, as well as by some other characteristic remains. The articular head in this specimen is equally compressed, and shows the same prominent apex, but is without the anconal deflection, which distinguishes the larger species. The lower half of the head is narrower transversely, and separated from the internal trochanter by a wider notch. The median ridge, moreover, on the anconal face is much more acute.

Measurements.

Greatest diameter of proximal end of humerus,	13·25 mm.
Vertical diameter of articular head,	8·
Transverse diameter,	4·
Least diameter of shaft below proximal end,	3·1
Greatest diameter of metacarpal, at distal end,	5·5
Least diameter,	3·75

The known remains of this species are from the same locality and geological horizon as the preceding, and were also discovered by John G. Meirs, Esq.

Graculavus anceps, sp. nov.

The only fossil bird remains secured during the explorations of the Yale College party of 1870 in the Cretaceous beds of Kansas, although special search for them was made, was the distal extremity of a left metacarpal, which is so well preserved and so characteristic a part of the skeleton, that it indicates with considerable certainty the affinities of the bird to which it belonged. A careful comparison of this specimen with the corresponding bone in recent birds has made it apparent that the species was a near ally of the Cormorants, and it may therefore be referred provisionally to the genus *Graculavus*, until further discoveries determine its position more accurately. The specimen implies a species about the size of the Violet-green Cormorant (*Graculus violaceus* Gray) of the Pacific coast, and one somewhat larger than *Graculavus velox*, described above. From the metacarpal of the former it differs essentially in having the articular face for the external digit broader and nearly flat, the face for the small inner digit considerably smaller and oval in outline, and the intervening tubercle much more prominent.

Measurements.

Greatest diameter of distal end,	6·75 mm.
Least diameter of distal end,	5·
Transverse diameter of outer articular face,	5·
Vertical diameter,	2·25

This specimen was found by the writer in the gray, upper Cretaceous shale, on the North Fork of the Smoky Hill River, in Western Kansas.

Palæotringa vagans, sp. nov.

The existence of a new wading bird in the Cretaceous greensand of New Jersey is plainly shown by an interesting fossil recently presented to the Yale Museum. The specimen is the greater portion of the shaft and distal end of a left tibia, somewhat injured, but with its more characteristic portions still preserved. It indicates a bird somewhat smaller than *Palæotringa littoralis*, described by the writer from the same locality,* but is probably a closely allied form. From the tibia of that species, the present specimen may readily be distinguished by the proportionally more narrow and shallow tendinal canal, on the anterior face of the distal end, and by the more depressed supra-tendinal bridge. The trochlear surface, also, on the posterior side contracts more rapidly, and at its superior margin passes directly, and not abruptly, into the shaft.

Measurements.

Length of portion preserved,	62· mm.
Approximate width of condyles in front,	8·
Width of bridge at center,	2·15
Transverse diameter of lower outlet,	1·5
Transverse diameter of shaft where broken,	5·
Antero-posterior diameter,	4·

This unique specimen was discovered at Hornerstown, New Jersey, about ten feet below the surface of the marl, and was presented to the Yale Museum by John G. Meirs, Esq.

Yale College, New Haven, April 10th, 1872.

ART. XLIX.—*On a proposed method of estimating Ethylic Alcohol when present in Methylic Alcohol;* by M. CAREY LEA, Philadelphia.

WHILE engaged in the study of some methyl compounds, I met with a method, which has recently been published in England, for effecting the above object with approximate correctness. As any simple means of accomplishing this result

* This Journal, vol. xlix, p. 208, March, 1870.

would be useful, I have made an examination of the proposed method, which is as follows:

Methylic oxalate is first to be prepared from the specimen of methylic alcohol to be examined, by distilling it with sulphuric and oxalic acids. After separating the methylic oxalate from the distillate, its melting point is to be determined, and this melting point is affirmed to fix approximately the quantity of ethylic alcohol present, the melting point being lower in proportion to the ethylic alcohol contained in the methylic.*

This was tested as follows:

1. Some good wood-spirit, which I had distilled over caustic soda, was heated with oxalic and sulphuric acids, and the crystals of methylic oxalate separated from the distillate. It was not stated whether the melting point of the crystals was to be taken while they were still wet, or after drying. Apparently the first was intended; I tried, however, in both ways.
2. The adhering liquid was squeezed out as completely as possible with a spatula, the mass was liquified by heat, and a thermometric bulb placed in it.
   Crystals first appeared at ..... 102° F.
   The liquid became thick with crystals at ... 100° F.
3. The crystals were next taken out and dried on blotting paper; as soon as dry were tried again. Result:
   Crystals first appeared at ..... 128° F.
   The liquid became thick with crystals at .... 127° F.
4. Nine volumes of the same wood-spirit were next mixed with one volume of 95 pr. ct (by vol.) alcohol, and the experiment repeated.
5. The crystals of methylic oxalate were freed from adhering liquid as far as could be done by pressure, the mass was liquified, and as it cooled,
   Crystals first appeared at ..... 98° F.
   The liquid became thick with crystals at ..... 97° F.
6. These crystals were dried as before, and then fused and cooled.
   Crystals began to form at ..... 128° F.
   " became thick " ..... 127° F.

It thus appears that the melting point of the crystals, if they have been dried on blotting paper, is precisely the same whether prepared from methylic alcohol nearly pure, or containing about ten per cent of ethylic alcohol. So that no inferences can be drawn from this.

When the crystals have been simply squeezed, the congealing point appears to be lower when ethylic alcohol has been

* A table has been given to show the relation:

Per cent of	ethylic alcohol,	0	Methylic oxalate solidifies at or about	104°F.
"	"	"	5	"	"	"	"	95°
"	"	"	10	"	"	"	"	86°
"	"	"	15	"	"	"	"	76°

present, and when, consequently, the liquid which moistens the crystals contains ethylic oxalate. But it seems evident that the congealing point will depend quite as much on the amount of liquid which chances to be left with the crystals, as upon the purity of the wood-spirit, so that two operators working with the same materials would be apt to get quite different results.

Accordingly, the congealing point attained at (5) compared with the table would indicate the presence of 3–4 per cent of ethylic alcohol, whereas there was present about ten per cent. This conclusion is to be regretted, as the method, if reliable, would have been valuable.

March 2, 1872.

ART. L.—*Discovery of a New Planet;* by Prof. JAMES C. WATSON. From a letter to one of the editors, dated Ann Arbor, April 4, 1872.

I DISCOVERED last night, in the constellation Virgo, a planet hitherto unknown, of which I have observed the following places:

	Ann Arbor M. T.			α			δ		
1872.	April 3,	12^h	20^m	0^s	13^h	23^m	$43{\cdot}13$		
	3, 13	51	30		13	23	$40{\cdot}42$	$-9°$	$28'$ $20''{\cdot}1$
	3. 15	13	43		13	23	$37{\cdot}59$	-9	27 42 $\cdot 8$
	Hourly motion,			$\Delta\alpha = -2^s{\cdot}0$			$\Delta\delta = +27''{\cdot}0.$		

The planet shines like a star of the eleventh magnitude.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On the aromatic phosphines.*—A. W. HOFMANN has obtained the first known members of the series of aromatic phosphines corresponding to the aromatic ammonias. When two molecules of chloride of benzyl, two molecules of iodide of phosphonium, and one molecule of oxide of zinc are heated together in a closed tube, a white crystalline mass is formed, from which the author obtained a colorless liquid boiling at 180° C., and having the formula, $P\left\{\begin{matrix}C_7H_7\\H\\H\end{matrix}\right.$, which is that of benzyl-phosphine. The liquid is insoluble in water, but soluble in alcohol and ether, and yields a crystallized iodhydrate, which has the formula $C_7H_{10}PI$. The corresponding chlorhydrate and bromhydrate appear not to crys-

tallize; the platinum salt forms a yellow insoluble precipitate. Benzyl-phosphine is formed according to the equation:

$$2C_7H_7Cl+2PH_4I+ZnO = 2PC_7H_7 . H_3I+ZnCl_2+OH^2.$$

Dibenzyl-phosphine remains in the retort after distilling off the volatile products. When pure, it forms brilliant crystalline needles, which are perfectly free from taste and smell, and insoluble in water. Dibenzyl-phosphine, $P\begin{cases} C_7H_7 \\ C_7H_7 \\ H \end{cases}$, does not unite with acids or even with platinic chloride: oxygen exerts no action upon it even at a high temperature. Its formation is expressed by the equation:

$$2C_7H_7Cl+PH_4I+ZnO = P(C_7H_7)_2H_2I+ZnCl_2+OH_2.$$

Besides these products, the mother-liquor of dibenzyl-phosphine contains a sticky body insoluble in alcohol, which appears to possess acid properties, but which the author has not succeeded in obtaining in a state of purity.—*Berichte der Deutschen Chemischen Gesellschaft, Jahrgang* v, p. 100. W. G.

2. *On the products of the oxidation of the methyl- and ethyl-phosphines.*—When a slow current of methyl-phosphine is conducted into fuming nitric acid, oxidation takes place, accompanied by the formation of a new acid, which HOFMANN terms monomethyl-phosphinic acid. The acid may be obtained pure by decomposing the lead salt by sulphydric acid. It is a white crystalline mass resembling spermaceti, which is hygroscopic but not deliquescent. It dissolves readily in water; the solution reddens litmus paper, and has a pleasant acid taste. The stability of the acid is remarkable, as it may be repeatedly evaporated with aqua regia without the slightest change. The acid melts at 105° C., and may be, in great measure at least, distilled without change. Its constitution is expressed by the formula $P(CH_3)H_2O_3$: it is bibasic or diatomic, and forms two series of salts, which have respectively the formulas $P(CH_3)HMO_3$ and $P(CH_3)M_2O_3$. Many of the metallic salts are insoluble or soluble with difficulty. Hofmann describes the salts of silver, lead and barium. By the action of nitric acid upon dimethyl-phosphine, the author obtained a second acid, which he terms dimethyl-phosphinic acid, and which has the formula $P(CH_3)_2HO_2$. It is a white crystalline mass resembling paraffin, very soluble in water, alcohol and ether. The crystals melt at 76° C., and volatilize at a higher temperature without decomposition. The silver salt of this acid has the formula $P(CH_3)_2AgO_2$; it presents fine felted needles extremely soluble in water. The barium and lead salts are uncrystalline, and dry to clear masses like varnish. Hofmann also briefly describes the two corresponding ethyl-acids, the first being crystalline, the second fluid even at −25°. The constitution of the new acids becomes intelligible if we regard them as derivatives from orthophosphoric acid, in which methyl replaces hydroxyl, OH.

Thus we have for the phosphorus and corresponding arsenic series the following formulas:

Orthophosphoric acid, $P\Theta\begin{cases}\Theta H\\ \Theta H,\\ \Theta H\end{cases}$ Orthoarsenic acid, $As\Theta\begin{cases}\Theta H\\ \Theta H,\\ \Theta H\end{cases}$

Methyl-phosphinic acid, $P\Theta\begin{cases}\mathrm{C}H_3\\ \Theta H\\ \Theta H\end{cases}$, Arsen-monomethylic acid, $As\Theta\begin{cases}\mathrm{C}H_3\\ \Theta H\\ \Theta H\end{cases}$,

Dimethyl-phosphinic acid, $P\Theta\begin{cases}\mathrm{C}H_3\\ \mathrm{C}H_3,\\ \Theta H\end{cases}$ Kakodylic acid, $As\Theta\begin{cases}\mathrm{C}H_3\\ \mathrm{C}H_3,\\ \Theta H\end{cases}$

Trimethyl-phosphin oxide, $P\Theta\begin{cases}\mathrm{C}H_3\\ \mathrm{C}H_3,\\ \mathrm{C}H_3\end{cases}$ Trimethyl-arsin oxide, $As\Theta\begin{cases}\mathrm{C}H_3\\ \mathrm{C}H_3.\\ \mathrm{C}H_3\end{cases}$

—*Berichte der Deutschen chem. Gesellschaft, Jahrgang* v, p. 104.

W. G.

3. *On the compounds of Tungsten.*—Roscoe has communicated the results of an elaborate and most successful study of the compounds of tungsten with chlorine and bromine. The author began by preparing pure metallic tungsten by the reduction of pure tungstic oxide, $W\Theta_3$. The density of the metal at 12° C. was found to be 19·261. Hexachloride of tungsten is prepared by heating the metal in a current of dry chlorine perfectly free from air. The metal takes fire in the gas at a moderate heat, and forms a sublimate of dark violet crystals, which may be purified by repeated distillations in an atmosphere of chlorine, and finally by distillation in a current of hydrogen. Pure hexachloride, WCl_6, is very slowly attacked by cold water; but if traces of the oxychloride, $W\Theta Cl_4$, are present, it is immediately decomposed into a green oxygen compound. It is easily soluble in bisulphide of carbon, and crystallizes from the solution in hexagonal scales. Its melting point is 275° C., and its point of solidification 270°. Its vapor-density at 440° C. was found to be 168·8; at 350°, 190·6. This points clearly to a dissociation, which experiment showed actually to take place; the hexachloride gives pentachloride, WCl_5, and free chlorine.

By reducing the hexachloride in a current of hydrogen, and repeatedly distilling the product in the same gas, long, black, brilliant needles of pure pentachloride, WCl_5, are obtained, which, when rubbed to powder, have a dark green color like that of potassic manganate. The crystals are very hygroscopic; they fuse at 248° C., solidify at 242° C., and boil at 275°·6 C. The vapor-density at 440° was found to be 186·2, the computed density being 180·7 (H=1). Hence the chloride contains one atom of metal. With water it yields the blue oxide, $W_2\Theta_5$, and chlorhydric acid.

Tetrachloride of tungsten, WCl_4, remains as a loose, gray-brown, crystalline powder when the hexachloride, or a mixture of hexachloride and pentachloride, is distilled in a current of hydro-

gen or carbonic acid. It is not volatile, and does not melt under ordinary pressures, but is decomposed by heat into pentachloride and dichloride. At the melting point of zinc, hydrogen reduces it to metal. Water gives a brown oxide ($W\Theta_2$?) and chlorhydric acid. The dichloride, WCl_2, is prepared by moderately heating the tetrachloride, or by reducing the hexachloride at very high temperatures. It is a gray uncrystalline powder, which is decomposed by water, with evolution of hydrogen and formation of a brown oxide. The author did not succeed in obtaining the chlorides WCl and WCl_3.

The two oxychlorides, $W\Theta Cl_4$ and $W\Theta_2Cl_2$, are well known. The monoxychloride, $W\Theta Cl_4$, forms ruby-red needles, which melt at 210°·4, solidify at 206°·7, and boil at 227°·5 C. Its vapor-density corresponds with theory (171). The dioxychloride is best prepared by heating the brown oxide in chlorine. It remains liquid at 440°.

Bromine vapor acts rapidly upon heated tungsten, forming even when excess of bromine is present only the pentabromide, WBr_5. The crystals of this compound have a dark color and metallic luster; melt at 276°, solidify at 273°, and boil at 333° C. Water decomposes it into the blue oxide and bromhydric acid. When heated to 350° in hydrogen it yields a body which is probably WBr_3, but which is very readily decomposed, giving a black powder, which is the dibromide. The two oxybromides, $W\Theta Br_4$ and $W\Theta_2Br_2$, are formed simultaneously by heating a mixture of two parts of the dioxide and one part of the metal in bromine, and may easily be separated by sublimation, the monoxybromide being much the more volatile, fusing at 277°, and boiling at 327·5°. It is readily decomposed by water, while the dioxybromide sublimes only at a red heat, and is not decomposed by water. Roscoe found for the atomic weight of tungsten the number 184·04, which agrees with that generally received.—*Berichte der Deutschen chem. Gesellschaft, Jahrgang* v, p. 118. W. G.

4. *On the Decomposition of Potassium Chlorate.*—Baudrimont has investigated the conditions under which potassium chlorate is decomposed, when heated both alone and when mixed with other substances. He finds that this salt melts at 370° C., and begins to evolve oxygen at 400°; that, heated more strongly, oxygen is explosively disengaged, and the temperature rises spontaneously to incandescence, thus proving potassium chlorate to be endothermic. When mixed with a fifth of its weight of cupric oxide, prepared by precipitation, its oxygen is evolved at 240° (160° lower than before) rapidly but uniformly, the sole solid product being potassium chloride. No perchlorate is produced under these circumstances, nor does the cupric oxide undergo any change. The nature of the substance employed was also investigated; it appears that certain substances, such as platinum sponge, argentic oxide, and mercuric oxide, do not in the least facilitate the decomposition; while others, as manganese dioxide and cupric oxide, and, in a less degree, ferric oxide, cobaltic oxide, manga-

noso-manganic oxide, and lead peroxide, cause the evolution of oxygen at temperatures varying from 240° to 360°. The author observed that fine division facilitated the action, precipitated oxides acting more efficiently than those prepared by calcination; that, while the effect of even $\frac{1}{500}$ is noticeable, yet that from $\frac{1}{8}$ to $\frac{1}{2}$ of the oxide is the most efficient quantity; that with these mixtures the rapidity of the decomposition is proportional to the temperature; and that no chlorine is evolved below 300°. Moreover, certain substances, which act chemically on the chlorate, decompose it at even lower temperatures. Thus chromic oxide causes the liberation from it of chlorine and oxygen even below 200°; and a complete transformation into potassium chromate is effected below 290°. Stannic, tungstic, silicic and boric oxides act similarly. Baudrimont attributes the result, in the case of cupric oxide and allied bodies, solely to the action of presence or contact; the point of fusion of the mixture being ten degrees lower than that of the unmixed chlorate.—*Moniteur Scientifique*, xiii, 783, Nov., 1871. G. F. B.

5. *A delicate Test for Phenol.*—Landolt, wishing to detect the presence of phenol (carbolic acid) in a well-water from the vicinity of a gas-works, and finding that the ferric chloride test is only of moderate delicacy, and is interfered with even by normal salts, as sodium sulphate, made use of bromine-water. When used in excess, this reagent gives, even with a solution of phenol in 43,700 parts of water, an immediate bulky precipitate of tribromophenol. The odor of phenol cannot be recognized when the solution contains less than 1 of phenol to 2800 of water; and the color developed by ferric chloride appears only when there is more than 1 of phenol to 2100 of water. By this test, the presence of phenol may be shown in 500 c. c. of urine. It may also be used quantitatively.—*Ber. Berl. chem. Ges.*, iv, 770, Oct., 1871.

G. F. B.

6. *On the Physiological Action of Tobacco.*—Vohl and Eulenberg have investigated the narcotic action of tobacco, especially examining the action of the constituents of tobacco-smoke. Finding that the amount of nicotine in snuff is only from ·0392 to ·062 per cent, and in the strongest chewing tobacco only a mere trace or none at all, they conclude that the use of such tobacco cannot result in nicotine-poisoning. They examined a smoking tobacco—which contained four per cent of nicotine—by burning it, one part in a pipe, the other made up into cigars, and drawing the smoke—by means of an aspirator—first through potash-solution to retain the acids, and then through dilute sulphuric acid to collect the bases. The gaseous products were found to consist of oxygen, nitrogen, carbonic oxide and marsh gas. An oily semi-solid substance collected on the surface of the potash-solution, which afforded, when distilled, an oily liquid of sp. gr. 0·8, apparently a mixture of hydrocarbons of the benzol series, and a solid, in pearly scales, having the composition $C_{19}H_{18}$. The potash-solution was distilled, and the distillate was added to the sulphuric acid solu-

tion. The residue, when acidified, gave off a large amount of gas, consisting of carbonic dioxide, hydrogen cyanide and hydrogen sulphide. On distilling the acidified potash-solution, formic, acetic, propionic, butyric, valeric, and carbolic acids, and doubtfully caproic, caprylic, and succinic acids, were detected. The sulphuric acid through which the smoke had passed, which was thick and of a dark brown color, was filtered, partially evaporated, and neutralized with caustic potash; ammoniacal vapors escaped, and a brown oil rose to the surface. On re-distilling, after saturation with potash, ammonia and ethylamine were found in the most volatile portions; the remainder of the distillate was acidified and evaporated, treated first with potassium hydrate and then with ether; the etherial solution distilled, the residue dried and submitted to fractional distillation. The bases were still further purified by re-crystallization of their platinum salts. In this way the whole series of the so-called pyridine bases was obtained, as follows: *Pyridine* C_5H_5N, *Picoline* C_6H_7N, *Lutidine* C_7H_9N, *Collidine* $C_8H_{11}N$, *Parvoline* $C_9H_{13}N$, *Coridine* $C_{10}H_{15}N$, *Rubidine* $C_{11}H_{17}N$, and probably *Viridine* $C_{12}H_{19}N$. No trace of nicotine was found.

The authors investigated the physiological action of (1) those bases volatile below 160° and (2) of those volatile between 160° and 250°. Both portions act like nicotine, producing contraction of the pupil, difficult respiration, general convulsions and death. They act more quickly by the stomach than when sub-cutaneously injected, but even then are not as prompt as nicotine. On post-mortem examination, the lungs and air-passages were found to be highly congested. They think that the disagreeable symptoms produced in the incipient smoker, and the chronic affections which excessive smoking produces, as well as the poisonous effects of tobacco-juice when swallowed, are due to the pyridine and picoline bases, and not to nicotine. They explain the fact that stronger tobacco can be smoked in cigars than in a pipe, by finding that more of the volatile bases are present in the smoke of a pipe; more especially of the very volatile and stupefying pyridine; while in a cigar, little pyridine and much collidine are formed.

The authors compared this action with that of the bases obtained from other plants used for smoking; with those from dandelion, willow wood and stramonium, and with pure picoline from Boghead coal. The action was entirely similar, but with the exception of the willow wood bases, they produced no contraction of the pupil. Picoline in vapor is extremely poisonous, producing great irritation of the air-passages, convulsions and death. From these results, the authors believe that the different effects of smoking opium are due simply to a difference in the proportion of the bases produced by its combustion.—*Arch. Pharm.*, II, cxlvii 130; *J. Ch. Soc.*, II, ix, 1075, Nov., 1871. G. F. B.

II. Geology and Natural History.

1. *The Hassler Expedition. Tomocaris Peircei.*—In a letter to Prof. Peirce, dated Rio, Feb. 12, and recently published, Prof. Agassiz announces the discovery of a new crustacean answering fully to his statement in a former letter, that among these animals we may expect to find "genera reminding us of some Amphipods, and Isopods aping still more closely the Trilobites than *Serolis*." This crustacean, which Prof. Agassiz names *Tomocaris Peircei*, was dredged in 45 fathoms about 40 miles east of Cape Frio. It is described as very like *Serolis*, with the marked difference, that the thoracic rings are much more numerous, and the abdomen much smaller; and it is said that its resemblance to Trilobites is unmistakable and very striking, and that it can be referred to no one of the orders or families in Milne Edwards' or Dana's classification.

From the details of Professor Agassiz's description, the animal is evidently one of the Serolidæ, apparently congeneric, perhaps specifically identical, with the *Brongniartia trilobitoides* of Eights (Trans. Albany Institute, vol. ii, p. 53, pl. 1, 2, 1833), which is referred to the genus *Serolis* by Audouin and Milne Edwards (Archives du Muséum d'Hist. nat., tome ii, p. 29, pl. 2, fig. 11, 1839), and retained in the same genus by Milne Edwards in his great work (Hist. nat. des Crust., tome iii, p. 232, 1840). To make this apparent it is necessary to observe that what Prof. Agassiz calls the head includes the first thoracic segment, which in the *Serolidæ* is anchylosed with the head; that what he considers the three posterior segments of the thorax, have been regarded by carcinologists as belonging to the abdomen; and that, as a result of this first homology, what have been regarded as the anterior legs are called maxillipeds. The only point in the whole description which can militate against the view here expressed is in the description of the nine pairs of legs which are said to be "all alike in structure;" the six anterior pairs, however, are "larger than the three last, which are also more approximated to each other," thus agreeing perfectly in position with the three anterior abdominal legs of the ordinary Serolidæ. The perfect agreement in all other respects, however, leaves little doubt of the close affinity between *Tomocaris* and the *Brongniartia* of Eights.

It may be well to notice that among the species referred to *Serolis*, there are several genera, distinct from the typical *S. paradoxa*, and that the species described by Eights represents one of these, although the name *Brongniartia* is preoccupied.

S. I. Smith.

2. *Discovery of the tusk of an Elephant in Colorado.*—Concerning this discovery, mentioned at page 302, we have received the following note from Prof. Alfred P. Rockwell, dated Institute of Technology, Boston, April 4.

I see in the April number of the Journal a notice of the finding by Capt. Berthoud of the tusk of an elephant near Golden, Colo-

rado. It so happened that I was in Golden within a few days after Capt. Berthoud discovered this tusk, went with him to the spot, and dug it up with my own hands. It was broken considererably in getting it down the cañon, but the pieces, which Capt. Berthoud presented to the Institute of Technology, are now in our collection.

Capt. Berthoud has anticipated me in the sending to you the notice of the discovery. I will only add that the gravel was tolerably compact in which it was firmly bedded, and consisted of rounded pebbles, boulders, and sand; it was arranged in distinctly horizontal layers, and had not been disturbed since its original deposition. It was a small patch preserved in a peculiar way between two projecting points of rock and was evidently but the remnant of what must have once filled the cañon to that height. The width of the cañon at that point may have been 200 to 300 feet. I saw no beds of gravel lower down the cañon.

The gravel bed was covered by about 6 feet of "slide" or débris from the mountain. It was easy to mark the dividing line between it and the gravel. No other bones were found near this tusk. The exact elevation of the spot where the tusk was found is 5675 feet above the level of the sea, as determined by the railroad survey. This is nearly 1000 feet above Denver.

Higher up the valley, at Idaho city, are considerable deposits of gravel similarly arranged in horizontal layers. Still higher up the valley are other deposits of gravel, but whether they are in layers, I cannot say. The general course of the valley is that given by Capt. Berthoud.

3. *On the Elephant in Colorado;* by ALFRED A. WOODHULL, Assist. Surgeon, U. S. A. (From a letter to one of the editors dated Fort Lyon, Colorado, March 15th, 1872.)—About a year ago two teeth of the *Elephas Americanus* were discovered (and are yet preserved) near this post, and another bone, which I judged to be the fibula, was exposed but quickly crumbled.

I am perfectly satisfied as to the identity of the animal. The question is as to the geological character of the bed. It is within a few yards of the Arkansas river and is composed exclusively of coarse sand and small, water-worn, quartzose pebbles. This region is underlaid with sandstone, barren of fossils, that is exposed on the higher ground, and this water-worn débris, deeper toward the river, covers it for various depths up to twelve or more feet, being itself mingled in its superficial parts with ordinary soil as it recedes from the river. How far back from the river this gravelly formation extends, I am not certain, but I think at least several miles. It is imperfectly terraced, especially on the north side of the stream; one level reaches from 20 to 1500 yards from the river, and above this a second terrace is irregularly discernible.

4. *On two new Ornithosaurians from Kansas;* by EDWARD D. COPE. (Read before the American Philosophical Society, March 1st, 1872.)—In this paper two species of Pterodactyls are described, which are identical with two of those described by Professor Marsh in the last number of this Journal, pp. 241–247, viz:

Ornithochirus umbrosus Cope = *Pterodactylus ingens* Marsh, and *Ornithochirus harpyia* Cope = *Pterodactylus occidentalis* Marsh. As separate copies of Prof. Marsh's article were distributed March 7th, while the paper of Prof. Cope was not issued before March 12th, the names given by Prof. Marsh have priority.

5. *Preliminary Report of the U. S. Geological Survey of Montana and portions of adjacent Territory, being a fifth Annual Report of Progress;* by F. V. HAYDEN, U. S. Geologist. Conducted under the authority of the Secretary of the Interior. Washington, 1872.—This Report by Dr. Hayden is one of unusual interest. It gives his account of the explorations in the remarkable Yellowstone Geyser region, a part of which has appeared under his name in this volume, besides notes on the geology along the route from Ogden, Utah, to Fort Hall in Idaho, Fort Ellis in Montana, and the Yellowstone; and thence from Fort Ellis to Snake River basin, Fort Hall, Bear River valley, and Evanston, on the Union Pacific railroad; and the text is illustrated by many sketches and several maps.

Dr. Hayden's special report is followed by a preliminary report on the minerals, thermal waters, etc., by Dr. A. C. Peale. We find in it that the siliceous deposit of the springs (geyserite, a variety of opal) afforded in one analysis, silica 83·83, water 11·02, chloride of magnesium 4·00=98·85; the specific gravity was 1·866, and hardness 5. The coal bed, about a mile from Evanston in Utah, is stated to be from 22 to 32 feet in thickness, being thickest to the north; it is one of the largest and best coal mines in the west. Dr. Peale's brief report is followed by other reports as follows:

On the Agricultural Resources of the Territories, by Prof. Cyrus Thomas; on the fossil Flora, Cretaceous and Tertiary, by L. Lesquereux; on the Geology and Paleontology of the Cretaceous Strata of Kansas, by E. D. Cope; on the Vertebrate Fossils of the Wahsatch Group, by E. D. Cope; on the Fossil Vertebrates of the Early Tertiary of Wyoming, by J. Leidy; a preliminary list of the fossils collected by Dr. Hayden's Exploring Expedition of 1871, with descriptions of a few new species, by F. B. Meek; besides zoological reports, on some worms, by Dr. Leidy, on Coleoptera, by Dr. G. H. Horn, on Hemiptera, by P. R. Uhler, on Orthoptera, by Prof. C. Thomas, on Butterflies, by W. H. Edwards, on Reptiles and Fishes, by E. D. Cope; a catalogue of plants, by Prof. T. C. Porter; and of the Mosses, by L. Lesquereux; and, as Part V, an account of the Meteorology of the region, by J. W. Beaman. The volume contains thus a very large contribution to our knowledge of the physical features and condition, the geology, and natural history, of a considerable part of the Rocky Mountain region.

6. *Dana's Mineralogy. Appendix to the Fifth Edition.* 20 and iv pages, 8vo.—An appendix to the last edition of Dana's Mineralogy has just been issued by the publishers, J. Wiley & Son of New York. It has been prepared by Professor G. J. BRUSH. It contains descriptions of eighty-seven minerals proposed as new

during the past four years since the Mineralogy was published, and also notices of some important facts regarding a few old species. The place of each new species in the system is shown by giving it a number corresponding to the position in the series. 19 of the so-called new species belong to the group of sulphides, arsenides, etc.; 4 to that of chlorides and fluorides; 8 are oxides; 8 anhydrous silicates; 23 hydrous silicates; 2 tantalates and columbates; 14 phosphates, arsenates, etc.; 3 borates; 4 tungstates, molybdates, vanadates; 5 sulphates, chromates; 1 carbonate; 1 oxalate; 7 carbohydrogen compounds.

7. *Bentham, Revision of the genus Cassia.* (From Trans. Linn. Soc., xxvii). Read March, 1869. Printed May–July, 1871. 4to, pp. 503–591, with 4 plates.—The earlier pages of this monograph are devoted to a survey of the genus, its systematic history, schemes of arrangement, and geographical distribution of the species. The latter topic is considered under the light which botanical affinity and geographical habitation mutually throw upon each other. Like many large tropical genera, *Cassia* exhibits "phenomena which may be shortly summed up as a general diffusion of uniform primary types, with more or less of divergence into secondary types in different directions in different countries, the smaller groups becoming, generally speaking, more and more local, diverging in different directions and with different combinations of characters in different countries, and the number of identical species over the whole range very few, beyond those which, as weeds of cultivation, are liable to frequent interchange by existing means of transport." It is premised that in the treatment of all such questions, "it seems necessary to consider, as an established fact, the great principle that natural affinity results from community of descent." To anyone who would see with what good account this principle may be recognized and employed in the hands of a naturalist who is completely familiar with the known facts, we commend the present brief discussion.

Three sub-genera are admitted, and these are recognizable by the flower as well as by the fruit. The first, *Fistula*, has only twenty admitted species; the second, *Senna*, over 160; the third, *Lasiorhegma*, about the same number. After vast reduction, Mr. Bentham has still to recognize 338 species. One from Arizona, *C. Covesii* Gray, in Proceed. Am. Acad., vii, p. 399, has been overlooked, naturally enough, as it was out of place in a supplement to the paper it appeared in. It is most probably *Cassia crotalarioides* Kunth, which Bentham describes as having sometimes as few as two pairs of leaflets.

Determinations of some of the principal collections distributed under numbers are appended, a great help to the possessors of large herbaria.

We may here enumerate synoptically the species inhabiting the United States—all of them on the Atlantic side, or along the Mexican frontier. One or two of them have not actually been found within our territorial limits.

Of the *Senna* sub-genus,—known by the pods never opening elastically, the seeds on slender stalks, and the sutural lines of the anthers glabrous—we have at most fourteen species, viz:

I. With short and turgid pod, no gland on base of petiole (all Texano-Mexican species), and

(1.) A single pair of leaflets.

C. pumilio Gray: very dwarf; leaflets linear, and peduncle one-flowered.

C. Rœmeriana Scheele: less dwarf; leaflets lanceolate, smoothish, and peduncle few-flowered.

C. bauhinioides Gray: dwarf; leaflets oblique and ovate-oblong, downy.

(2.) Two or more pairs of oval-oblong leaflets: soft-downy plants, 2 feet high or more.

C. Covesii Gray (omitted by Bentham, but almost certainly *C. crotalariodes* Kunth): with 2 or 3 pairs of leaflets, and pubescent pod hardly an inch long.

C. Lindheimeriana Scheele: with 5 or 6 pairs of leaflets, and a longer pod.

II. With long and narrow or flat pod, and

(1.) A gland on the base of the petiole, none between the leaflets.

C. leptocarpa Benth., from New Mexico and Arizona: has numerous, lanceolate, very acuminate leaflets, and very slender curved pod, 6 to 10 inches long.

C. occidentalis L., naturalized on our southern borders: has 4 or 5 pairs of ovate or ovate-lanceolate acuminate leaflets, and thickish-margined slightly curved pod, 3 to 5 inches long.

C. Marilandica L., the only species of *Senna* found wild as far north as New England: has 6 to 9 pairs of lanceolate-oblong acutish leaflets, flowers crowded in short-peduncled or almost sessile axillary clusters, and a broadish linear flat pod, 3 or 4 inches long.

(*C. ligustrina* L., a West-Indian species of this group, with numerous oblong-lanceolate acute leaflets, larger flowers than those of the preceding, in a more terminal corymb or panicle, and a smooth pod, 3 or 4 inches long, we still suppose is wrongly credited to the United States. We have, however, cultivated specimens, said to come from Louisiana and Texas, of *C. lævigata* Willd. This is known, in flower, by the fewer leaflets, with glands between them.)

(2.) No gland on the petiole, one between each pair of leaflets or some of them.

C. Tora L., to which is joined *C. obtusifolia* L., the common American form: annual herb, with mostly three pairs of wedge-obovate leaflets, and the seeds lengthwise in the very long and narrow commonly curved pod. In the other species they lie crosswise or oblique.

C. Bahamensis Mill., which occurs on the Florida Keys, and has been referred to *C. angustisiliqua* Lam. (which is a form of

the next): shrub, with three to five pairs of oblong leaflets, a gland between the lower pair; anthers all beakless.

C. biflora L., a tropical American species, which barely reaches the Mexican frontier: shrub, with 3 to 8 pairs of oblong leaflets, and the tips of two or three of the lower anthers prolonged into a slender beak.

(3.) No gland either between the leaflets or on petiole.

C. Wislizeni Gray, of Arizona: shrub, with 4 to 7 pairs of very small, coriaceous, obovate leaflets, large flowers, and linear flat pod, 3 or 4 inches long.

Of the *Lasiorhegma* sub-genus—the pods of which open elastically, and the sutural lines of the anthers are mostly woolly-pubescent—our representatives are all of the *Chamæcrista* section.

Sub-section *Xerocalyx*, so well marked by its rather rigid and striate, many-nerved sepals, has one tropical species, which has advanced into Texas, viz:

C. calycioides DC., which is No. 2036 of Berlandier's collection, found on the banks of the Rio Medina.

Sub-section *Leiocalyx*, with thin sepals not striate, affords the following:

(1.) Leaflets only 4 to 6 pairs: flowers rather large.

C. Wrightii Gray, from Arizona: wholly glabrous, low, from a woody perennial root-stock: veins of the narrowly-oblong leaflets nearly simple and inconspicuous.

C. grammica Spreng., a West Indian species, of which we find specimens from Key West: diffuse, soft-pubescent throughout; the slightly inequilateral-oblong or cuneate-oblong and rather coriaceous leaflets lineate with the strong pinnate veins.

C. Greggii Gray, from Tamaulipas province, at some distance south of the Rio Grande: a rigid, shrubby species, with reticulate veins to the coriaceous leaflets.

(2.) Leaflets 8 to 20 pairs.

C. nictitans L.: a widely-diffused annual, extending north into New England, known by its small and subsessile flowers, with only 5 (or at most 6) anthers.

C. Chamæcrista L., of about the same geographical distribution, and even more variable, is an annual, or in some southern forms perhaps perennial: has large flowers on slender pedicels, 10 unequal stamens, and thinnish leaflets, with midrib either not far from central or less so, and pinnately-veined on both sides. There are cinereous Texan forms, with the veining inconspicuous or obscure, of which Lindheimer's 232 (coll. 2) is the most remarkable.

C. procumbens L. (Herbarium, and of the Spec. Pl. in part only the *C. chamæcristoides* of Colladon), a low perennial or suffrutescent species, of tropical America, and, if rightly identified, also of southern Texas. In his list of determinations, Bentham refers both 2427 and 2479 of Berlandier's collections to *C. procumbens:* in his monograph he mentions the former under *C. procumbens* as seemingly a rather larger variety, with larger stipules and flowers, and longer pedicels, and cites the latter under

C. cinerea Cham. and Schlecht., in the dimidiate division. Now our specimens under the two numbers are both alike, and, in the lack of authentic specimens of the species they have been referred to, we cannot now decide to which they belong. But our Texan plant should be known by its leaflets, which are linear, rigid, and 3–4-nerved from the base, the nerves of about equal strength, one of them near the upper margin, but often sending off one or two very short veinlets on that side, and a marginal nerve is more or less apparent. A synonym of the Texan species, whatever it be, is *C. Texana* Buckley, in Proceed. Acad. Nat. Sci. Philad., Dec., 1861. (We now learn that Mr. Bentham regards the whole as a doubtful variety of *C. procumbens*, and that the reference to *C. cinerea* was an oversight.) A. G.

8. *Delpino, on the Fertilization of Coniferæ, and on the Genealogy of the Artemisiaceous tribe of Compositæ as deduced from their mode of fertilization.*—Prof. Delpino, of Florence, now Professor in the State Forest School established at Vallombrosa, is best known in the country for his able annotations upon a paper of E. Müller's, which he translated into Italian, upon the "Application of the Darwinian Theory to Flowers and to the Insects which visit them," the whole paper having been reproduced in English, under this title, in the American Naturalist, last year. Delpino has been paying much attention to dichogamous flowers, and to the difference between those fertilized by the wind (*anemophilous*), or by insects (*entomophilous*), or by animals of whatever sort *zoidiophilous*, as he terms them. *Coniferæ*, as is well known, are *anemophilous*, that is, their fecundation is entrusted to the wind; their light and most abundant pollen is correlated to this, and the structure of the fertile inflorescence is such that the pollen reaches the very orifice of the ovule. In Yew and Cypress, and in other if not all other genera of the sub-orders they represent, Delpino finds that, at the time when the ovule is ready for fecundation, a minute clear drop of liquid appears at the orifice of the ovule; grains of pollen falling upon this are retained, are incited by it to develop the pollen-tube into the liquid first, thence into the ovule, and the drop is then re-absorbed or dries up. Alph. De Candolle, in a recent number of the *Arch. des Science de la Bibl. Universelle*, calls attention to the fact that this droplet was known, as to its appearance, function, and re-absorption, to his late venerable townsman, Vaucher, and is described in his Physiology of the Plants of Europe, published in 1841.

That *Artemisia* should be widely separated from *Ambrosia*, *Xanthium*, and their allies, must be regarded as an imperfection in the Lessingian arrangement of *Compositæ*, as adopted by De Candolle. We have reason to suppose that the next elaboration of the order will bring them together, and that irrespective of the considerations now brought to bear by Delpino, which certainly have their weight and offer confirmation strong, and very likely independent. The point made by Delpino is, that whereas this vast order of *Compositæ* is especially constructed on *dichogamous entomophilous* principles, i. e., for cross-fertilization by in-

sect agency, one group only is *anemophilous*, namely the *Artemisiaceæ* taken in the extended sense as above indicated. From a study of the floral structure and arrangement in reference to fecundation, Delpino proposes a new classification of the members of his sub-family *Artemisiaceæ*, which need not here be detailed. It calls for the re-establishment of the genera into which *Artemisia* has been divided, and for an equivalent disruption of *Franseria*, &c., which our systematists will not be disposed to adopt. Yet characters of this sort, standing as they must in intimate relation with the well being and continuance of the species, will doubtless prove to be of real classificatory value, and be turned to important account as such.

Prof. Delpino closes this last paper with a brief genealogical commentary, in which, by the application of principles which there is not room here to explain, he makes the ingenious but hardy attempt to trace the filiation of this group in question,—viz., from *Campanulaceæ* through *Lobeliaceæ* to *Compositæ*, in which the *Senecionideæ* offset *Artemisiæ*, and one set of these produced *Iva;* this, the Ambrosineous genera, and from *Ambrosia* through *Franseria* to *Xanthium*, our troublesome cockle-bur.

A. G.

9. *J. Müller, on the Cyathium of Euphorbia.*—The monographer of *Euphorbiaceæ* (*Euphorbia* excepted) in De Candolle's Prodromus, has discussed this question in the *Flora* for Feb. 11, *apropos* to Warming's paper, of which we gave some account in our February number. Dr. Müller confirms the Brownian view throughout, and gives new arguments for regarding the stamineal column below the articulation as a pedicel, and the stamen as "appendicular," notwithstanding its terminal position, in opposition to Warming, who thought it might be truly "apical" or "cauline." Analogies are brought from the structure of other *Euphorbiaceæ*, with which Dr. Müller is so familiar. Species are mentioned of *Euphorbia* in which the calyx of the female flower is unequivocally developed, our *E. hexagona* Nutt. being one. A. G.

16. *Action of foreign Pollen on the Fruit of the fertilized Plant.*—In the Bulletin of the St. Petersburg Academy for November, 1871, Maximowicz has collected the observations and a few experiments upon this subject, and recorded one experiment of his own. He mutually crossed *Lilium Davuricum* and *L. bulbiferum*. Now these have been taken for one and the same by late writers, but are neatly characterized, according to Maximowicz, by the form of their capsule and bulb-scales. In the single experiment the pistil of *L. bulbiferum*, fertilized by the pollen of *L. Davuricum*, set fruit, but failed to mature it. That of *L. Davuricum* fertilized by the pollen of *L. bulbiferum* matured well, but to the surprise of the observer, it formed the long capsule of *L. bulbiferum* instead of the short one of the species. The experiment should be repeated, as it doubtless will be in the ensuing season. A. G.

11. *A. Grisebach, Die Vegetation der Erde nach ihrer klimatischen Anordnung: Ein Abriss der vergleichenden Geographie der Pflanzen.* Leipsic, W. Engelmann, 1872. 2 vols. 8vo.—This new

sketch of the earth's Vegetation in its relations to Climate or Comparative Geography of Plants, upon which Prof. Grisebach of Göttingen has long been occupied, has just reached us, and may hereafter receive the further report which this elaborate treatise deserves, especially if the English translation which has been called for should appear. The work is strictly a geography of plants, and it treats of the climates and vegetations of the twenty-four regions into which the author divides the earth, so that it is upon a plan wholly different from Alphonse DeCandolle's work.

A. G.

12. Mr. Ravenel's interesting notice of the *Arrangement and Morphology of the Leaves of Baptisia perfoliata*, as set forth by the present writer in the December number of this Journal, is reprinted here, as well as in the Annals and Magazine of Natural History; and the perusal brings to our view an abominable misprint, which makes utter nonsense of the last sentence of the penultimate paragraph, to be corrected as follows: A. G.

Correction.—In vol. ii, No. 12, p. 463, in line 11, for "fusion" read *torsion;* line 12, for "adopting" read *adapting;* so that the sentence will read: "in the torsion of the axis and the distribution of the stomata, adapting the foliage to its vertical position."

A. G.

13. *Catalogue of the Phænogamous Plants of the United States, East of the Mississippi, and of the Vascular Cryptogamous Plants of North America, North of Mexico.*—Second edition, revised and corrected. Cambridge, 1872. Published by B. Pickman Mann.—This is merely a reprint, with corrections and a few additions, of the Catalogue known familiarly as "Mann's Exchange List," which has been of great service to all collectors of American plants. Since the running numbers have not been changed, it will be possible to use the old and the new editions interchangeably. The "typographical and other errors," which have been found and corrected, are over one hundred and fifty, and Mr. Mann, in his preface, renews his brother's request that persons using the Catalogue would send him notice of all errors discovered. D. C. E.

14. *Illustrated Catalogue of the Museum of Comparative Zoölogy. Supplement to the Ophiuridæ and Astrophytidæ;* by Theodore Lyman.—(Concluded from page 225.) The part of Mr. Lyman's work on which I have most to say is his "Note on Nomenclature, etc.," which is in fact a direct reply to some remarks of mine in a note to the third part of my "*Additamenta*" (p. 50). The prominent place given to Mr. Lyman's reply may excuse my answering it at greater length than its somewhat "terse" language—to use the expression of the reviewer in the "American Naturalist"—might otherwise have induced me to do; and if it needs any apology that I am only coming forward with old ideas and well-known facts, my apology must be, that when a simple truth has not been appreciated and comprehended at its value, there is no other method of getting it into people's heads than trying if a repeated exposition of it will not succeed in procuring it access.

The first part of my note reads as follows: "Though highly valuing the great care with which Mr. Lyman's 'Catalogue' is worked up, and fully acknowledging its great scientific importance, I cannot but blame the unreasonable manner in which he upholds the (fictitious) rights of priority of authors before Linné. Thus *Astrophyton muricatum* (Lmk.) is named *A. costosum*, because it is thus named by Seba (!); *Ophiothrix fragilis* (Abgd.) gives way to *O. rosula* (Linck); *Ophioderma lacertosa* (Lmk.) to *Ophiura levis* ("*Stella levis*?") (Rondelet); *Ophiura texturata* (Lmk.) to *Ophioglypha lacertosa* (Linck),—it is quite another thing if you will, with Mr. Norman, recur to Pennant and write *O. lacertosa* (Pnt.); *Ophiopholis aculeata* (Müll.) to *O. bellis* (Linck). Certainly it ought now to be known, that a specific name can not seek its priority in the time before Linné, when the binominal principle was not yet invented; when there, for this very reason, existed no *true* specific names, but only diagnoses or 'phrases caractéristiques' as means of designating the species, although those diagnoses or short descriptions did sometimes consist of a single word. As to *A. costosum*, the application of this name to *A. muricatum* (Lmk.) is the more useless, because the *Euryale costosa* of Lamarck is, as pointed out by Mr. Lyman himself, a West Indian species, different from *A. muricatum* and from the other two species known from this archipelago."

To this Mr. Lyman gives the following answer: "As to the first of these propositions" ("that names prior to Linnæus have no place in present nomenclature"—after all not a very correct comprehension of my proposition) "I may say, that Linnæus first contrived what is called binomial nomenclature, in which each animal has two names—the generic and the specific. Consistency is the first duty of a naturalist, therefore it was the first duty of the followers of Linnæus to respect and to adopt such binomial names as may be found in ante-Linnæan authors, of whom some were among the most celebrated of zoölogists. When, then, I find the name *Astrophyton costosum* distinctly used by Seba (iii, pl. ix, f. 1, p. 16, 1758), and moreover an excellent figure given, I shall certainly apply that name to the West Indian species to which it belongs. Did not Seba, more than a century ago, publish a fine folio with figures that are better than some of those we see now-a-days, and shall we ignore his names, when they are such as may properly be taken?" But this splendid edifice Mr. Lyman himself destroys in adding: "In putting such a name as *Ophiopholis bellis* for *O. aculeata* I think I have gone too far, because the name *bellis* of Linck is used as part of a diagnosis, and not as a name." In fact, the use of "*Ophiopholis bellis*" is in no way different from all the others, against whose substitution for names given after the introduction of the binominal system of nomenclature I have made a protest.

Let us consult, e. g., "The Revised Rules of Zoölogical Nomenclature, adopted by the British Association in 1865" (with notes by A. E. Verrill, 1869), p. 6:* "As our subject-matter is strictly

* This Journal, II, vol. xlviii.

confined to the *binomial system of nomenclature*, or that which indicates species by means of two Latin words, the one generic, the other specific, and as this invaluable method originated solely with Linnæus, it is clear that, as far as species are concerned, we ought not to attempt to carry back the principle of priority beyond the date of the twelfth edition of the '*Systema Naturæ*, 1766.'" [As pointed out in the note, this should have been corrected to the *tenth* edition of 1758; in a few instances one is compelled to go a little further back, i. e. to the "*Museum Tessinianum*," 1753, when the binominal system was already fairly established.] "Previous to that period naturalists were wont to indicate species not by a *name* comprised in one word, but by a *definition* which occupied a sentence, the extreme verbosity of which method was productive of great inconvenience. It is true that one word sometimes sufficed for the definition of a species, but these rare cases were only binominal *by accident* and not by principle, and ought not, therefore, in any instance to supersede the binomial designations imposed by Linnæus." Nothing can be more true, more lucid, more decisive, than this argumentation, and Mr. Lyman's eloquence falls completely to the ground before it. A glance at the works of Linck, Rondelet, Seba, etc., will convince every unbiased naturalist who knows something of the history of science, that these authors had only "definitions" or "phrases caractéristiques," and never meant to give anything else, though they, of course, often, for the sake of convenience, restricted their diagnostic descriptions to one or two words if these appeared sufficient for the purpose. Such designations as "*Stella lacertosa*," "*Rosula scolopendroides*," "*Bellis scolopendrica*," "*Astrophyton costosum*," are evidently only accidentally binominal, scattered as they are among polynominal ones of this character: "*Stella lumbricalis corpore pentagono lateribus lunatis*," "*Pentacerus gibbus et reticulatus*," "*Stella coriacea acutangula hispida*," "*Artocreas minimum ex insula St. Thomæ*," "*Artocreas marinum minusculum Curassaricum*," etc., and therefore have no right of priority. Moreover, if Mr. Lyman—in open rebellion against one of the universally adopted, simple and sound rules of science, followed *now-a-days*, if I am not mistaken, by *all* other zoölogists—will persevere in upholding the *binominal* character of the *biverbal phrases* cited above, he will—"consistency being the first duty of a naturalist"—be obliged to maintain their first part (*Stella*, *Rosula*, *Bellis*) as true generic, their second half as specific denominations. Instead of this, Mr. Lyman, in a quite arbitrary manner, in some instances prefers the first (pseudo-generic) to the second (pseudo-specific) part of the biverbal description, writing first *Ophiothrix rosula*, *Ophiopholis bellis*. This is perhaps the worst consequence of the practice advocated by Mr. Lyman, that it spreads confusion and capriciousness in nomenclature. I have no doubt, therefore, that it will be universally disapproved; but I thought it right, nevertheless, to protest against it, to prevent, if possible, younger naturalists from being induced to take it up.

The rule is very simple: *the priority of a specific name can not be sought in works in which the binominal system of nomenclature is not yet adopted.* A definite year, of course, cannot be pointed out, as a line of demarkation, as it took some time before the Linnæan principle was generally known and universally adopted. The character of the work must decide if its author ranks among the *Ophioderma* to *Ophiura*, *Ophiura* to *Ophioglypha*, etc.?—or to insinuate that I belong to a party who "insist on considering *credit* or *honor* the real reason for using names of authors." This is a gross and unfounded misunderstanding. I never said anything so absurd or narrow-minded; if others have, I am not responsible for them. The rights of an author (A) are not violated by *omitting* his name altogether, but they certainly are *binominal* or the *polynominal* authors, and consequently, if his specific designations have a claim on priority or not. To be sure, Linck and Seba are not among the number!

In the second part of the note alluded to I uttered the following: "There is written so much against the bad practice, that the author of a new genus or generic denomination puts *his own* name after the specific names previously invented by other authors, that it cannot but excite astonishment to see this practice not only generally adopted by most American authors, but also in a work published under the auspices of a scientific celebrity. This is so evident a violation of the rights of the author, and so conspicuously *dangerous to the sound development of science*, that I am at a loss to conceive how this bad practice can still find followers, and that not all naturalists have adopted the simple practice to put the name of the original author of the specific name into parenthesis when the generic denomination has been altered, thus avoiding every ambiguity."

I can perhaps admire the adroitness of Mr. Lyman's reply to this remark, but am sorry that I cannot fully acknowledge its correctness. Mr. Lyman has no right to impute to me any anxiousness for my "reputation"—owing, I think, to the loss of the species to which my name would cease to be attached, in consequence of some unnecessary changes of generic names,* i. e. by substituting another (B) in its place, giving it the appearance as if the principal part of the work done respecting the discovery, description and systematic registration of the species was due to B and consequently not to A. But I am very willing to admit,

* Respecting these substitutions I wrote as follows (Addit. iii, p. 69): "Though I have perhaps myself occasioned this substitution of names through my remarks (l. c. p. 31) on the application of the name *Ophiura*, I am now not sure that it was the right thing to be done. When Forbes and Müller and Troschel divided the genus *Ophiura* (Ag.), they ought certainly to have left this name with the '*Ophiodermas*;' but as they did no such thing, and Forbes limited and defined his genus *Ophiura* in a perfectly correct manner, as did Müller and Troschel their *Ophioderma*, I cannot see that we are now justified in altering them again, not to speak of the rights attained by their being used in many important works. If zoölogists will agree in retaining the names *Ophioglypha* and *Ophioderma* (as done by Mr. Ljungman), *Ophiura* can conveniently be used as a collective designation for all generically undefined or undefinable (i. e. many fossil) species."

that this "violation of rights" is only a matter of secondary importance, and if anybody will argue that it is of no importance at all, I shall not dispute the point further. But the principle followed by Mr. Lyman, and, I believe, by all American authors,* is *prejudicial*, because it will tempt vain men—and many good men *are* vain, naturalists not the least—to create a host of unnecessary new genera or generic denominations, with the evident or secret intention to make an easy harvest of species, to which *their own* name of authority might henceforward be attached, giving in that manner to the common or unscientific reader a false impression of their influence upon the development of natural history, *exempla sunt odiosa!* The only efficient means to stop this fatal practice is clinging to the well-established rule, that the name of the author who first *established and published* a species shall remain with it, may the generic appellation be changed or not—a rule adopted, I believe, by most of the European authors who have paid any attention to this vexed question of nomenclature, and without exception by all *Scandinavian* naturalists.† The practice against which I thought it proper to remonstrate is further only capable of causing confusion and loss of time. Strangely enough, Mr. Lyman and his allies defend their cause by arguing that "nomenclature is a system of exact registration;" very true, but for *the very cause of* "*exact registration*" it is absolutely necessary that the student is referred at once to the author who *first* published the species, and not to him who afterward referred it to another genus, subdivided the old one, rebaptized it, or perhaps only reformed its orthography, knowing himself, perhaps, nothing of the species, or having sometimes quite a different thing in view. I shall give an example that will, I hope, act as an "*argumentum ad hominem.*" If I am right (as I think I am) in reducing the new genera, *Ophiomaza*, *Ophiomitra* and *Ophiothamnus*, the species now referred to them ought henceforward to be written thus: *Ophiocnemis cacaotica* (Lym.), *Ophiacantha vicaria* (Lym.), *valida* (Lym.) and *sertata* (Lym.), thus referring the reader to consult the works of Mr. Lyman to find the first information, registered in the annals of science, of these animals; if, according to Mr. Lyman, they are written *Ophiocnemis cacaotica* Ltk., *Ophiacantha vicaria* Ltk., etc., the future student will "*operam et oleum perdere*" in finding out where in the world Mr. Lütken had anything to do with these

* In regard to this point Dr. Lütken is quite mistaken, for many American naturalists have always and still do, in all cases, write the name of the original describer of the species. See for examples Prof. Dana's Reports on the Zoöphytes and Crustacea of the U. S. Exploring Expedition, 1846–1852; numerous papers by Dr. Stimpson; most of the zoölogical publications of the Smithsonian Institution, etc. In Prof. Dana's works, the name of the *original* describer of the species is *always* given in parenthesis. Others do this when the synonymy is not given in connection with the species.—EDS.

† Not all of these, however, put the name of authority in parenthesis when the generic name has been changed; Lovén, Sars, Ljungman, etc., usually add, in parenthesis, the name of the old genus, writing, e. g. *Tritonium reticulatum* (*Pleurotoma*) Brown, *Ophiactis Balli* (*Ophiocoma*) Thompson, etc.

species; and if, accidentally, he is acquainted with the fact, that Mr. Lyman established years ago some species with the same specific, but with different generic names, he will, nevertheless, know nothing about their relations to the species he did find enumerated, e. g. in some faunistic, systematic, anatomical, etc., work under *my* authority; whereas, he will be on the right track instantly if that of Mr. Lyman be used instead of mine—the name of this gentleman being of course put in parenthesis, to indicate that his original generic denomination has been changed. The "rules of zoölogical nomenclature," therefore, are very correct in stating that, "in giving the authority for the *specific* name in preference to all others, the inquirer is referred *directly* to the original description, habitat, etc., of the species, and is at the same time reminded of its discovery." "Therefore it is recommended that the authority for a specific name, when not applying to the generic name, should be expressed thus: (Linn.) as *Tyrannus crinitus* (Linn.)."

When Mr. Lyman concludes his remarks with stating that he had no objection to my "Synopsis" provided it be understood as a movement toward a true classification, or as a really convenient tabulation of genera," I must say, that I do not know what I should have expected more, and that my own words amply show that I did not expect more. But when he adds: "Inasmuch as it rests on the structure of the mouth-parts, it cannot be expected to be an exposition of nature any more than a classification of fishes based on their scales, of mammalia on their nervous centres, or mollusks on the character of their shells," he would no doubt have been more just in comparing a classification of the *Ophiuridæ*, based (reluctantly) on the character of the mouth, with the classifications established in *Mammalia*, *Ophidia*, *Gasteropoda*, *Arthropoda*, etc., on the teeth or other "*organa cibaria*"—classifications which are, to say the least, generally esteemed as tolerable approximations to an "exposition of nature." The true system—some naturalists will tell us that such a thing does *not* exist—will only be finally found when all genera (recent and fossil) are known, i. e., it will *never* be found! Every contribution that leads us nearer to this ideal is, however, a step in the desired direction; and we shall be very glad, therefore, to welcome any future communications from Mr. Lyman about the results of his researches on the *Ophiuridæ* in the European museums!

Copenhagen, Dec., 1871. CHR. LÜTKEN.

15. *Additional Note on the Rules of Nomenclature;* by A. E. VERRILL.—Although agreeing in most respects with the views of Dr. Lütken, and especially in regard to the extension of the rule of priority to the ante-Linnean authors, the writer acknowledges that he is one of those "American authors" who believe in and practice the custom of writing the name of the author who first gave the *correct binomial name* to a species, as the authority for *that particular name*. It seems fitting, therefore, to given some of the arguments in favor of this practice (by no means confined to *American* authors), as briefly as possible:

1st. The name of a *species is binomial*, and the *first* part is just as important an element as the *second*. Is the *family* name of a man less important than his Christian name?

2nd. The matter of "credit" or "honor," by some supposed to be connected with the attachment of a man's name to a species, is of little or no account; but if it were of *more* importance, *justice* would demand that we should write as authority the name of the author who has done the most work on the species, or who has given us its complete anatomy and history. Certainly the writers who have, like Linné, Lamarck, Fabricicus, and many others, described vast numbers of species under useless or artificial general in loose, indefinite, Latin diagnoses of two or three lines, costing them perhaps half an hour of time, but costing subsequent naturalists, in the aggregate, many months or years of labor to unravel and understand, are not deserving of more consideration than later systematists, who by a prolonged and careful study of the anatomy have shown their true structure, and have thus arranged them in natural groups, and so brought them properly into the "domain of science."

3d. As to the matter of *convenience*, or saving of time, it seems to me that the argument is opposed to the system advocated by Dr. Lütken. Is it not customary, in looking up unfamiliar names, to consult the *index* of a book? But if the *generic* name has been changed, how can we expect to find in an author's index a name falsely attributed to him, which he never used, and would perhaps have been offended with? If we look through the body of the work we do not fare better, though our labor is increased, for the same specific name may occur many times. Thus, if any one not perfectly familiar with conchological literature undertakes to use, for instance, the Genera of Recent Mollusca, by H. & A. Adams, he constantly finds scores of names of species under genera that are new, or unfamiliar, or perhaps ante-Linnean, and used in a sense unlike that in which the same name is ordinarily used, but all the species have the name of the *original describer* after them (not even in parenthesis, though that would not help much), and if he seeks for the *species* in the works referred to, he must consume a great amount of time to no purpose. What assistance can it be to find Say's name, e. g., after such a name as *Anchistoma hirsutum*, unless we happen to know beforehand in what genus Say placed the species? I presume that every naturalist, however experienced, has met with similar inconvenience and loss of time in using this work. Those, in this country, who try to use the Smithsonian "Check Lists of Shells," constructed on the same plan, find the same and even worse inconveniences.

4th. As to the temptation it affords to vain or young naturalists to do poor or hasty work for the sake of perpetuating their names as "authorities," we have found that the *actual result* is just the opposite that which Dr. Lütken supposes. What can be a *greater check* upon such a person than the certainty that, if he makes a mistake in hastily describing a species, before he has ascertained its true structure and relations, his name will drop into the ob-

scurity of erroneous synomyms? What can be *more encouraging* to one of that class of persons than the certainty that if he names and describes a species, no matter how poorly, or in what false relations, or under what wrong genus, his name must nevertheless always remain attached to it? The effect of the "American" custom is certainly to induce naturalists to attach *more* importance to the study of the structure and true relations of species, and *less* to mere descriptions of new species. And in this country, where any naturalist can easily obtain at least 50 new species in an excursion of a single day, this is of much consequence for the future progress of the science.

16. *New Zoölogical Periodicals.**—No less than three zoölogical periodicals have lately made their appearance, and judging from their first numbers they are of great promise. The one, Archives de Zoölogie Expérimentale et Générale, issued by Professor Lacaze Duthiers, will take a high place among scientific periodicals, and is likely, in French zoölogical literature, to take the position which Siebold and Kölliker's Zeitschrift takes in Germany. Professor Lacaze Duthiers, so well known for his thorough researches upon the Invertebrates of the Mediterranean, contributes an introduction to the first number, stating the aims of the publication, and concludes the number by an elaborate article on the auditive capsules of Gasteropoda. The other original article of this number is written by Mr. Perrier, who has given us an excellent paper on the Natural History of a fresh-water worm (Deto) allied to Nais. This periodical, as well as the other "Journal de Zoölogie," published under the auspices of Professor Gervais, both have notes and reviews on scientific works published in countries outside of France, a feature which thus far has received but little attention from French scientific journals. Holland, which already publishes so many scientific memoirs and periodicals of great excellence, adds a purely zoölogical archive to its list, edited by Professor Selenka. The first number contains a tolerably complete embryology of one of the naked Gasteropods by Selenka, and a long paper by C. K. Hoffman on the anatomy of Echinoderms; both these papers are excellently illustrated. Professor Selenka intends to issue his Niederländische Archiv für Zoölogie whenever sufficient material is at hand; he solicits articles either in German, French or English. A. A.

17. *East India Crustaceans. On Indian and Malayan Telphusidæ*, Part I, by James Wood-Mason, Esq.—Mr. Mason is publishing excellent papers on Indian Crustaceans in the Journal of the Asiatic Society of Bengal. The paper on the Telphusidæ appears in vol. xl of this Journal. Figures are given of the several species, which are admirably drawn and lithographed.

18. *Greenland Meteorite.*—Mr. E. Seymour writes us from his office for the sale of rocks, minerals and fossils, 52 Beekman st., N. Y., as follows: I have been commissioned by Professor Norden-

* Archives de Zoologie Expérimentale et Générale. Sous la Direction de H. de Lacaze Duthiers. Paris.—Niederländische Archiv für Zoologie herausgegeben von Em. Selenka. Haarlem–Leipzig.—Journal de Zoologie par Paul Gervais. Paris.

skiöld, of Stockholm, Sweden, to sell one of the celebrated Greenland meteorites lately found by him. This meteorite weighs 10,000 lbs. and the price is $12,500 in gold. He has a few other large specimens, adapted to public collections, of smaller size. Specimens of any desired size may be obtained for private collections at $8.00 per pound or 75 cents per ounce.

III. Astronomy.

1. *Recent auroral displays in the United States.*—In vol. I, p. 146 (July, 1870), we have given the dates upon which auroras were reported by at least one of the observers of the Smithsonian Institution for the year 1869, and for three months of the year 1870. In vol. i, p. 309 (April, 1871), we gave the continuation of these observations to the close of the year 1870. We now furnish a similar summary for the year 1871. The observations for the first eight months of the year were taken from the monthly reports of the Department of Agriculture; the observations for the last four months were furnished by the Secretary of the Smithsonian Institution, the auroral observations having been omitted in the reports of the Department of Agriculture for these months. We regret to find in the February report the announcement that the publication of the meteorological tables in the monthly is discontinued. A large number of persons have been accustomed to consult these tables with great interest, and we trust the Commissioner of Agriculture will reconsider his decision respecting the publication of these tables.

Auroral displays in the United States in the year 1871.

Jan.	3, 6, 7, 10, 13, 16, 18, 19, 20, 23, 29,	Total 11 days.
Feb.	3, 10, 11, 12, 13, 15, 16, 20, 21, 22, 24, 26, 27,	" 13 "
March,	1, 2, 3, 9, 10, 15, 17, 19, 20, 22, 24, 25, 26, 27, 28,	" 15 "
April,	1, 5, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 29,	" 16 "
May,	1, 7, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 21, 22, 23, 25, 26,	" 17 "
June,	4, 7, 8, 9, 10, 11, 12, 14, 17, 18, 19, 21, 22, 23, 24, 26, 30,	" 17 "
July,	7, 8, 10, 20, 21, 22, 24, 26, 28.	" 9 "
Aug.	5, 9, 10, 11, 12, 13, 15, 16, 17, 19, 21, 23, 24,	" 13 "
Sept.	1, 2, 4, 6, 7, 8, 9, 10, 11, 13, 14, 17, 20,	" 13 "
Oct.	2, 4, 6, 7, 10, 12, 14, 15, 16, 17, 18, 19, 24, 25, 30,	" 15 "
Nov.	1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 23, 25,	" 19 "
Dec.	1, 8, 9, 10, 12, 13, 14, 16, 18, 23, 25, 28,	" 12 "
	Total for the year 1871,	170 days.

The following is a summary of the Smithsonian observations for the past three years:

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1869,	13	13	18	23	14	17	18	15	22	17	9	13	192
1870,	19	18	23	21	22	14	20	19	21	21	18	17	233
1871,	11	13	15	16	17	17	9	13	13	15	19	12	170

The correspondence of these results with the number of spots visible on the sun's surface is quite noticeable. The disturbance of the sun's surface attained its maximum in 1870, and is now rapidly declining. It is anticipated that the number of auroras visible in the United States in subsequent years will exhibit a similar decline.

E. L.

2. *Note on the Zodiacal Light.*—The *Comtes Rendus* for Jan. 22, 1872, contains an abstract from a note of Mr. E. Liais, giving the results of observations of the zodiacal light at Rio Janeiro and at various places upon the high plateaus of the interior of Brazil. Mr. Liais finds that the light is visible as far as the anti-solar point of the heavens. Polariscopic observations have not enabled him to discover any trace of polarization. He has also at various times within the last four years studied the light by the aid of the spectroscope, and has found that it gives a spectrum apparently continuous, though, perhaps, containing dark lines.

These results would indicate that the light is derived from the sun by reflection; and the absence of polarization, if certainly made out, shows that the matter reflecting the solar rays is not gaseous, but made up of solid corpuscles not endowed with the properties of specular reflection, but scattering the light irregularly. With regard to the connection between the base of the zodiacal light and the corona, he remarks that although the light in the latter is polarized, while that of the former is not so, a fact indicating that the latter is gaseous, and the former composed of solid particles, the corona may possibly be the base of the zodiacal light, its gaseous condition being a result of its proximity to the sun, in consequence of which the solid particles are volatilized by the intense heat.

The observations of Janssen during the recent solar eclipse are of interest here, as confirming the polarization of the corona, and showing that it emits light giving a continuous spectrum with the solar dark lines.

Angström on one occasion observed the bright line of the auroral spectrum in that of the zodiacal light; but that it belongs to the spectrum of the latter is rendered doubtful by the fact that it has been observed in the light from all portions of the sky on nights in which the whole heavens were feebly luminous with a diffuse light. The essentially monochromatic character of this light would render the line visible even when superposed upon the spectrum of the zodiacal light, as, if the latter is really continuous, it would be extremely feeble when observed with an instrument of high dispersive power.

Polariscopic observations upon the zodiacal light were made at Agosta in December, 1869, by the members of the eclipse expedition, and are reported by Mr. A. C. Ranyard in the Monthly Notices of the Royal Ast. Soc., for March 10, 1870. On the evening of the 19th, the light being especially brilliant, Mr. Ranyard observed it with a Savart's polariscope, and thought that he detected dark bands indicating polarization in a plane passing through the sun. This observation was confirmed by Mr. Burton of the same party, who, on looking through the instrument, saw the dark bands distinctly. On the following evening the light was visible but less brilliant than before, and Secchi thought he detected faint bands on viewing it with a Savart, but was not sure of his observation. These results are in opposition to those of M. Liais, and indicate that the light is reflected, either from mat-

ter in such a condition that its particles are small compared with the wave-length of light, hence possibly in the form of gas, or from matter capable of giving specular reflection. It is not impossible indeed that the light consisted of portions reflected in both modes, the relative proportions of polarized and unpolarized light varying in different times of the year and in different parts of the earth's orbit, and further observations are needed in order to determine this point. A. W. W.

3. *The American Eclipse Expedition.* (From "*Nature*," of Feb. 22.)—I deem it but proper and just that I should correct a mistake that has just met my eye in Dr. Schellen's excellent work on Spectrum Analysis.

On page 332 of the 2nd German edition we find "Die erstere Expedition wählte unter der Anführung von Professor Morton die Stationen im Staate Iowa,

"(1) Burlington mit den Beobachtern Professor Mayer, Kendall, Willard, Phillips, und Mahoney, denen sich der als gewandter Spectroskpist bekannte Dr. C. A. Young, Professor am Dartmouth College (Hanover), und *Dr. B. A. Gould für die photographischen Aufnahmen hinzugestellen.*"

In the English translation, edited by Mr. Huggins, the above reads, "The first expedition, under the guidance of Professor Morton, selected stations in the State of Iowa as follows:—

"(1) Burlington, where its observers were Professor Mayer, and Messrs. Kendall, Willard, Phillips, and Mahoney, together with Dr. C. A. Young, Professor of Dartmouth College (Hanover), well known as an experienced spectroscopist, and Dr. B. A. Gould, to whose charge the photographic department was committed."

Dr. Gould had no connection with the photographic expedition, but placed himself under Professor Coffin's general organization, so that he could have facilities for making observations on the corona, and in searching for the suspected intermercurial planet.

The Burlington station of the Philadelphia eclipse expedition was placed under the direction of Dr. Alfred M. Mayer, and the photographs pointing page 337 of Dr. Schellen's work are two of the five plates secured by him during totality.

Also the diagram on page 338 is from Dr. Mayer's report on the eclipse (published October, 1869), an abstract of which, with accompanying copies on glass of the original negatives, was presented by M. Delaunay to the Institute of France. The Rev. T. W. Webb laid them before the Royal Astronomical Society, where the report and the photographs were discussed at length at the meeting of November 12, 1869.

HENRY MORTON, President
Stevens Institute of Technology, Hoboken, New Jersey.

4. *Aurora of February 4th.*—This aurora, particular account of which is given by Prof. Twining at page 273 of this volume, was seen at Suez and also at Bombay.

It was also observed at the Cape of Good Hope, as announced in the following account by E. J. Stone of the Royal Observatory at the Cape, dated Feb. 19, copied from *Nature* of April 4. An

aurora of a very unusual splendor for the latitude was seen here on Sunday evening, February 4, 1872. The sky, extending in azimuth over 197° from N. E. to nearly W. S. W., was generally illuminated. The brilliance of the glow varied considerably in different directions from time to time during the night. On the south horizon there was a bright bluish segment of light, whose position in azimuth and brilliance varied slightly from time to time. The streamers were well seen, and their convergence toward the point to which the south pole of a magnet is directed could be most distinctly traced. The streamers extended at about nine o'clock to the constellation Orion, and Sirius was well within the auroral glow. With a spectroscope I saw one bright line in the spectrum of the auroral light, but the spectrum was too faint to allow of any successful attempt to determine the refrangibility of the light. Unfortunately our magnetical equipment is such that I can give no information respecting the extent of the magnetical disturbance at the time. The aurora was seen as far north as Bloemfontein, latitude 29° 8′ south. A faint aurora was seen here in October, 1870, but no such aurora as that of February 4, 1872, appears to have been visible for at least fifty years. The aurora was well seen over a large portion of the colony, and considerably frightened the natives.

5. *A New Planet* (118).—Dr. R. Luther has discovered a minor planet (118), Peitho, at Bilk.

1872.	M. T. at Bilk. h. m. s.		h. m. s.		° ′ ″
March 15,	14 18 59·6	R.A. =	12 7 26·73	N.P.D. =	79 42 33·5

An observation made by Dr. Tietjen, at Berlin, is as follows:

1872.	M. T. at Berlin. h. m. s.		h. m. s.		° ′ ″
March 21,	9 33 23	R.A. =	12 1 36·36	N.P.D. =	78 20 46·1

The daily motion obtained from these observations is in R.A. −60ˢ·6, and in N.P.D. −3′ 45″. The planet is of the eleventh magnitude.—*Athenæum*, March 30, 1872.

IV. Miscellaneous Scientific Intelligence.

1. *Topography of the Punjab Oil Region;* by Benjamin Smith Lyman, Mining Engineer. 14 pp. 4to. (From the Trans. Amer. Phil. Soc., vol. xv, p. 1.)—The oil of this region, according to Mr. Lyman, comes mainly from rocks of the Eocene Tertiary age, part of which are nummulitic. The following observations are made on the oil.

The oil has been bored upon at Gunda, and at first fifty gallons of it a day were pumped from the well; but the yield, of course, grew quickly less (like the ordinates of a parabola), and after the whole amount had reached two thousand gallons (about five months), the daily yield was less than ten gallons. In the region, oil flows also at five other places from natural springs from a gill to three quarts a day, and there are traces of it at yet

two other places, making eight in all. Asphalt, or dried oil, is found in small quantities at four of these places, and at four other places, at two in notable quantities. At most of the asphalt places there are traces of rock tar or asphalt melted in the heat of the sun; and at one of them (Aluggud) as much as 100 gallons. Besides these dozen places where oil or asphalt is found, there are half a dozen places where there are small traces of one or the other, enough to attract notice in the minute examination of the country by its inhabitants. About half of all the places are in the northeastern corner of the region; about half toward the southwestern corner; and one or two in the northwestern corner toward the middle.

The Aluggud oil (now dried to asphalt) seems to have come from rocks of Carboniferous age, to judge by their fossils, though other things would rather show that they were of later age. If they are Carboniferous, then the nummulitic rocks are wanting above them, and have thinned completely away from a thickness of 2,000 feet, only thirty miles distant. This oil is also the only case of oil outside of the older Tertiary rocks anywhere in the whole region.

All the other oil springs or shows of oil in the southern part of the region, are on the northern side of the Salt Range, and in the nummulitic limerock or close above it. The northern ones are either in the nummulitic lime rock of the Choor Hills, the same probably as that of Salt Range; or in the Gunda rocks (chiefly sandrocks) that lie south of them, also accompanied by nummulites.

In every case the oil seems to come from a deposit of very small horizontal extent, sometimes only a few feet, seldom as much as a few hundred yards; only in one case, that of the Chhota Kutta and Burra Kutta oil springs, near Jaba, does the deposit seem to extend as much as half a mile. Here, too, the oil comes from a thickness of about a hundred feet, and the natural springs yield at one place as much as three quarts a day. At all the other places the oil comes from a much smaller thickness of rock, from forty feet at Aluggud and twenty at Gunda and Punnoba downward. Scarcely do any two oil springs come from the same bed of rock.

The oil is dark green in color, and so heavy as to mark 25° of Beaumè's scale, or even less. The Gunda oil has been burned a little by the natives with a simple wick, resting on the side of an open dish; but the Punnoba oil is more inflammable, and needs a special tube for the wick, though the main opening of the dish or lamp may stay uncovered. The oil, generally, however, has been little used for burning except at Punnoba; but has been sought for as a cure for the sore backs of camels. The asphalt was also highly prized forty years ago by the natives as medicine, taken in pills, especially for broken bones. It was carried far and wide, and was called "negro's fat," because it was generally believed to have dripped from the brain of a negro that had been hung up by the heels before a slow fire.

It is perhaps needless to say that there is nothing whatever in the mode of occurrence of the Punjab oil, to uphold the chimerical belief that rock oil ever passes by distillation, emanation, or otherwise, from one set of rocks to another, or that it originates in any different rocks from those in which it is found; and nothing to show that it has been formed by any other method than the very natural and sufficient one of the slow decomposition of organic matter, deposited along with the other materials of the rock. Neither is there anything to show that the oil has been driven by the upward pressure of water, from the lower parts of a bed of rock through its pores to a higher part of the same bed; on the contrary, as the rocks near most of the oil springs dip pretty steeply, if such an action of water were possible, all the oil would long ago have been altogether forced out of the rock at the outcrop. Indeed, such an idea is quite inconsistent with the fact that even a slight amount of oiliness in the pores of a body is a complete bar to the entrance of water; much less could water (without soap) scour the oil from one mass of rock and make it flow into another mass filled with moisture. If oil wells are more numerous in some regions along the tops of rock saddles, the reason is clear, that the oil-bearing bed lies too deep for boring conveniently elsewhere.

Wild hopes have sometimes been entertained that a large amount of oil might, by boring near the oil springs, be struck in some cavity below the oil-bearing bed; but it is safe to say that they are not justified by anything whatever, either in the Punjab or in any other part of the world, either in the practical experience of oil-boring or in the general laws of physics.

2. *The Pacific Gulf Stream, or Oceanic Current flowing northward along by the Asiatic Continent.*—S. Wells Williams, the distinguished Chinese scholar, has recently published a translation of the diary of a Chinese writer on an excursion to the Lewchew Islands on a Government expedition in 1801. Besides giving many interesting facts respecting the Lewchewans, it shows that the Pacific Gulf stream, *Kuro-Siwo* in Chinese, was then well known to the Chinese navigators. We copy a paragraph in evidence of this fact, and also to show something of the spirit of a Chinese traveller in those days. The author Li Ting-yuen was at the time the junior member of the Imperial Commission despatched from Pekin to accompany the Lewchewan delegation in 1801.

"The sailors came to us to-day, to say that it was the right time to sacrifice to the Heh-kao or Kuro-siwo, i. e. the Black Sewer; and it appears from the account of Wang, a former envoy to Lewchew, that it was the practice when the vessel reached the Kuro-siwo, to throw a live sheep and a pig into it to propitiate the god, and then to scare him by drawing up the guard on deck. We had now been out three days, and did not know where this Black Sewer ran; but the Lewchewan captain said, 'We go back and forth here, but do not know where it is, only when we see

Tiao-yu tia we know that the god resides there and then worship him out at sea, by throwing a live sheep and pig overboard, burning some silk and pouring out a libation, but we do not call out the guard.' The whole of to-day two vessels were seen some scores of miles ahead of us.*

3. *On the Climate of Boston.* From a recent meteorological article by R. T. PAINE, of Boston.—The three warmest of the last 47 years were in 1823, 1825 and 1870 (m. t. 51·71°, 51·43° and 51·22°); the three coldest were 1836, 1837 and 1868 (m. t. 46·01°, 46·66° and 47·12°); the extreme variation in the annual temperature is therefore here 5·70 degrees.

The extreme range of the thermometer at Boston in the 47 years, was 114 degrees, from 100° on July 11th, 1825, to 14 *below* zero on February 8th, 1861. The greatest *sudden* change was a fall of 60° in 18 hours, from 46° at one P. M. of February 7th, 1861, to 14° *below* 0 at sunrise of 8th; but three days, or 79 hours, later, on February 11th, noon, it had risen 74 degrees to 60 above 0.

The extremes of the barometer in the 47 years were 31·16 inches on February 5th, 1863, and 28·47 on November 25th, 1846—difference, 2·69 inches.

The average *annual* fall of rain in Boston is 45·73 inches; the greatest fall was 67·84 in 1863; the least only 29·95, in 1846; the greatest *monthly* fall was 12·50 inches, July, 1863; the least, 0·25 inches, in May, 1826, and 0·26 in December, 1828; but within the last 10 years, 0·62 inch, in September, 1865.

4. *Climate of the Post-tertiary, or Quaternary, after the Glacial era.*—The April number of Woodward's excellent "Geological Magazine," contains an important article on the post-glacial climate of Britain, by S. V. Wood, Jr., F.G.S., sustaining the view, before presented, that there was a second period of cold in the Quaternary. The existence, in caves and other quaternary deposits, of the remains of quadrupeds that required a temperate climate, and also in some places of the remains of the reindeer, a subarctic species, is thus accounted for. Various other arguments are brought to bear on the conclusion. Professor Geikie, in a following article, argues that the warm-climate quadrupeds may have been pre-glacial. But various facts bear against this view.

* Mr. Williams adds the following note:

This notice of the Great Pacific Gulf Stream is interesting as showing that Chinese and Japanese navigators had both noticed it and given it the same name of *Heh-shwui kao*, i. e. Black Water Channel or Sewer, or Black Sewer, which has the same meaning as *Kuro-siwo*. In a subsequent date, our traveler says he was talking with the Lewchewans about this stream. They said, "We have heard that on the surface of the ocean to the westward is the Kuro-siwo, and near the sea of Fuhkien; it was formerly called *Tsang-ming* and *Tungming;* we Lewchewans do not know about this and have never crossed it. Why is this?" I replied, "Many people cross the sea, but those who write about it are few: while those who are not sea-sick, and sit all day on the poop deck and there write down what they see, are fewer still. One man leads and all others follow, their ears devouring his words, but who can confidently believe all he says? This is the reason why the Lewchewans, though they annually cross the ocean, still know nothing about the *Kuro-siwo*, and constantly affirm that there is none."

5. *Colorado Expedition.*—Major POWELL has returned from the cañons of the Colorado, having left his party in the field in charge of Professor Thompson. Since the party started in April last, it has passed through the cañons of Green River and the cañons of the Colorado, to the mouth of the Paria, at the head of Marble Cañon. Here the major left his boats for the winter, and he expects to return as soon as there is a favorable stage of water, and embark for the second trip through the German Cañon.

On the way down the party explored the region to the west of the Green and Colorado, tracing the courses of the larger streams emptying into the two great rivers to their sources in the Wahsatch Mountains and Sevier Plateau, and examined the geology of the great mesas and cliffs.

Early in the winter a base-line 47,000 feet in length was measured on a meridian running south from Kanab, and the party is now engaged in extending a system of triangles along the cliffs and peaks among lateral cañons of the Colorado.

During the past season the party has discovered many more ruins of the communal houses once occupied by the prehistoric people of that land. Many of these houses stood on the cliffs overhanging the cañons, and many more are found in the valleys among the mountains to the west. Stone implements, pottery, basket-ware, and other articles were found buried in some of the ruins.

The major found a tribe of Utes on the Kaibab Plateau who still make stone arrow-heads and other stone implements, and he had opportunity to observe the process of manufacturing such tools.—X. *in Harper's Weekly.*

6. *Cruise of School-ship "Mercury" in the Tropical Atlantic Ocean*, 1870–1871. 34 pp. 8vo, with a map of the cruise.—This School-ship was sent out from New York by the Department of Public Charities and Correction of the city as a means of giving nautical instruction to vagrant boys. It sailed from New York by way of Madeira to the Canaries and Sierra Leone; thence through the tropics to Barbadoes; thence through the Caribbean Sea to the north of Cuba, and back to New York. The vessel was under the command of Capt. Giraud, and, in accordance with the orders received, he made lines of soundings, observations on the temperature of the air and water, and on currents. The results were submitted to Prof. Henry Draper, of the University of the city of New York, and are recorded in this pamphlet. The introduction says:

"Professor Draper's report, which is herewith submitted, contains precise tabulated statements of the meteorological observations of the voyage, of the direction and velocities of the currents, and of the temperatures at the several depths obtained, together with an analysis of the specimens of water from various depths. The report also contains a diagram of the bed of the Atlantic from Sierra Leone to Barbadoes, as established by the soundings, and is replete with interesting disquisitions on all the questions of deep-sea explorations. The specimens of animal life which were obtained from the bottom were forwarded for examination by Pro-

fessor Draper to Dr. Carpenter. He reports that they are the ordinary forms of deep-sea foraminifera. With the specimens Professor Draper also sent a table of the temperatures, and in respect to them Dr. Carpenter remarks, 'that they are of great interest, and especially those at one hundred and two hundred fathoms. They show,' he continues, 'how thin is the surface stratum affected by the gulf-stream, or by direct solar radiation. The sudden drop,' he remarks, 'in the temperature at two hundred fathoms, between 17° 46′ west longitude, and 19° 36′ west longitude, and the continuation of this reduction with the increased westing as far as 50° 38′ is a very curious phenomenon, and I cannot help connecting it with some great oceanic movement, especially as at 68° 47′ west longitude, and at 83° the higher temperatures reappear. I trust that hereafter much attention will be given to this point.'

"The conclusion at which Professor Draper has arrived, from a careful examination of the results obtained, is that there exists, all over the bottom of the Atlantic and Caribbean Sea, a stratum of cold water, and that the cruise of the Mercury must be considered as offering confirmatory proof of the correctness of Dr. Carpenter's theory, drawn from the cruises of the English exploring vessels, that there is a general movement of the lower waters of the Atlantic toward the equator, and a corresponding flow of the surface-waters toward the poles."

It should be here added that this movement of the oceanic waters was long since advocated by the meteorologist, Wm. C. Redfield, of New York.

7. *Public Aquarium at Naples.*—Anton Dohrn gives, in *Nature* of April 4, an account of the great aquarium in process of erection at Naples under his direction, besides discussing some of the objects which science may gain from it. The building is rectangular, measuring 100 feet by 70, with a height of 40 feet, and is 100 feet from the sea. The lower part is to be occupied by the tanks of the great aquarium, to be opened to the public; and the upper will contain twenty-four rooms for laboratories, a library and collections, with lodging rooms for three or four zoologists. There will be 53 tanks in the lower story, one of them 32 feet long, 10 broad and 3½ deep, another, 26 feet long, and twenty-six 3 feet by 3½ feet. The tanks throughout are furnished with a continuous current of sea water. Upstairs, the library room is large enough to hold 25,000 volumes. The principal laboratory room will contain twenty to thirty tanks of different sizes; and besides there are private laboratories for the chief zoologist and the first assistant, and other small laboratory rooms, and rooms for collections.

8. *Corrected longitude results across the North American Continent.* Note from G. W. Dean (April 8, 1872).—Soon after the paper relating to the "U. S. Coast Survey Longitude Determinations across the Continent" had been printed in the December number of this Journal,* it was discovered that the corrections for

* This Journal, III, ii, 447.

personal equation had inadvertently been applied to the longitude results, with the wrong algebraic sign. The following longitude results are therefore printed:

Stations.	Difference of longitude. λ			Personal equation.	Corrected difference of longitude.			Probable errors.
	h.	m.	s.	s.	h.	m.	s.	s.
Camb. to Omaha,	1	39	15·159	−·130	1	39	15·029	±·008
" to Salt Lake,	2	43	4·257	−·110	2	43	4·147	±·008
Omaha to "	1	3	49·081	+·020	1	3	49·101	±·008
Camb. to S. Fr'ncisco,	3	25	7·260	+·070	3	25	7·330	±·007
Omaha to "	1	45	52·094	+·200	1	45	52·294	±·010
Salt Lake to "	0	42	3·024	+·180	0	42	3·204	±·008

9. *A Contorted Halo;* by H. W. PARKER. (Communicated.)—A remarkable prismatic effect in a cloud, was visible at Amherst, Mass., 11 A. M., March 1st. A large, white sheet of cirro-stratus, at its doubly-lobed end near the sun, exhibited bright spectrum colors in bands of very irregular breadth, several times repeated, and flexed in zig-zag curves, accordant with the structure and outline of the mass. The beautiful iridescence covered nearly a third of the cloud, and the bands were bent far back on themselves, some of them even twice, with nothing of the figure of circular halos.

10. *Logan Chair of Geology in M' Gill University, Montreal.*—Sir William E. Logan has recently given $18,000, in addition to the sum of $2,000 before contributed by him, toward endowing the chair of geology in M'Gill College. Principal Dawson, under whose charge the department of geology has been for many years, will be the first occupant of the chair.

11. *American Association for the Advancement of Science.*—The 21st meeting is appointed to be held at San Francisco, California, to commence August 5th. Details of the arrangements, which are not yet perfected, will be announced in the next number of this Journal.

12. *British Association.*—The next meeting of this Association, the forty-second, will be held at Brighton, and will commence Wednesday, the 14th of August. Dr. Wm. B. Carpenter is president for the year.

13. *Annual Report of the Board of Regents of the Smithsonian Institution for* 1870. 494 pp. 8vo. Washington, 1871.—This Report contains in its valuable Appendix memoirs of Prof. A. D. Bache, Arago, Magnus, Prof. C. Dewey, besides papers—on the nature and origin of Force, by W. B. Taylor; on a Physical Laboratory, by Prof. Henry; on the relation of Food to Work, by Rev. S. Haughton, of Dublin; on the Diamond and other Precious Stones, by Babinet; and various papers on ethnological, physical, and meteorological subjects.

14. *Annals of the Lyceum of Natural History of New York.*—Nos. 4–5 of vol. x contain the following papers: on the lingual dentition of *Helix turbiniformis*, by T. Bland and W. G. Binney; on the *Ascidea Manhattensis* and *Mammaria Manhattensis*, by

J. A. Telkampf; on the N. American Crustacea in the Museum of the Smithsonian Institution, by Wm. Stimpson.

OBITUARY.

SAMUEL FINLEY BREESE MORSE.—Prof. Morse died at his residence in New York city, on the 4th of April, at the advanced age of 81 years. Few Americans have attained so world-wide a renown as Mr. Morse, growing chiefly out of his success in devising and introducing the system of electric telegraphy which bears his name. Mr. Morse was the eldest son of Jedidiah Morse, D.D., an American clergyman, better known as a geographer, whose writings were the first devoted to the elucidation of American geography, his educational works of this character remaining for more than a generation in general use.

Prof. Morse was born in Charlestown, Mass., April 27, 1791. He graduated at Yale College in 1810. His scientific tastes had their first development and stimulus while he was an undergraduate student of Prof. Silliman the elder, a warm personal attachment growing up between teacher and pupil, which endured undiminished to the end of two lives prolonged far beyond the usual term of human experience. But the first choice of Mr. Morse after graduation was for the fine arts, which he pursued in London in 1811 under Benjamin West the painter, in company for a time with Washington Allston. He was also successful in sculpture, his "Dying Hercules," which was crowned by the gold medal of the Adelphi Society of Arts of London, being esteemed as unsurpassed by any American artist to this day. The National Academy of Design of New York had its origin in 1826 chiefly from his efforts, and he was its first president, an office which he held by successive elections until 1842. His early scientific tastes were revived by his intimate associations with Prof. James Freeman Dana in New York, where the two were colleagues in the Athenæum. It was in Dana's hands that he saw for the first time, and immediately after its discovery by Sturgeon of England, a soft iron electro-magnet. In 1829 he again visited Europe in prosecution of his artistic studies, and while yet abroad was elected to the professorship of the literature of the arts of design in the University of the City of New York. The germs of his immortal invention, which were undoubtedly long before slumbering in his mind, appear to have been stimulated by a discussion which took place on board the packet-ship Sully in the autumn of 1832, while on his way to America, and then took on a more definite form; and soon after his arrival in New York he occupied himself in maturing his plans and realizing his conceptions by an attempt to construct an apparatus. In 1835 he completed his first rude single receiving instrument, which he produced in duplicate in 1837. In the number of this Journal for January, 1838,* will be found the first notice of the Morse system of telegraphic notation, with a specimen of the electrical record as then in use, and such as the writer saw it in the inventor's rooms in the University of New

* This Journal, I, xxxiii, 185.

York, in the autumn of 1837. Failing to secure any encouragement from the national government of his own country toward the construction of an experimental line, in 1838 he in vain sought aid or protection of his rights as an inventor in Great Britain and France; and it was only after several years of disappointment and poverty that he was gratified by the appropriation of $30,000 by the U. S. Congress (March 4th, 1843), for the purpose of encouraging his first attempt to construct a line of telegraph between Washington city and Baltimore, a work which, after many difficulties, he completed in 1844.

From that time to this the system of Morse has spread with great rapidity, until it now reaches the remotest hamlets of the North American continent, covering the whole land with its pulsating nerves of iron, and communicating with all the civilized regions of the globe, in most of which his system is the one in use. Honors were showered upon the inventor by most of the leading governments of Europe, either by decorations or by more substantial grants of money, in acknowledgment of his great services. His Alma Mater in 1848 gave him the degree of LL.D.

Prof. Morse was distinguished by great amenity of manner and kindliness of heart, which endeared him to a large circle of friends. He never claimed for himself the honors of a *scientific discoverer*, nor did he seek to enlarge the boundaries of human knowledge by original investigations. He was emphatically an *inventor*, using the discoveries of science to carry out and perfect his inventions. Gifted with a far-reaching mind, and indomitable energy, he conferred in this way a great blessing on the human race. B. S.

PICTET DE LA RIVE, the eminent Swiss physicist, died at Geneva on the 15th of March, at the age of sixty-two.

Die Elbthalgebirge in Sachsen, von Dr. H. B. Geinitz. Zweiter Theil. Seeschwämme, Korallen, Seeigel, Seesterne, und Haarsterne, mit 6 Tafeln Abbildungen.

Development of Limulus polyphemus, by A. S. Packard, Jr. (Mem. Boston Nat. Hist. Soc., Vol. II.)

Note sur les Tremblements de Terre en 1868, avec Supplements pour les années antérieurs de 1843 à 1867, par Alexis Perrey, Prof. Hon. à la Faculté des Sci. de Dijon. (Bull. Ac. Roy. de Belgique, Febr. 1870.)

Les Oscillations des Côtes de France, by A. Delesse. Delesse gives in this paper many facts with regard to modern changes of level on the coast of France. It is published in the Bulletin of the Société de Geographie for January, 1872.

Report of the Chief Commissioner of Mines for the Province of Nova Scotia, for the year 1871, by D. Honeyman. 88 pp. 8vo. Halifax, 1872.

Descriptions of some new species of fossils, from the shales of the Hudson river group in the vicinity of Cincinnati; by James Hall. Published October, 1871, in advance of the Twenty-fourth Report of the State Cabinet.

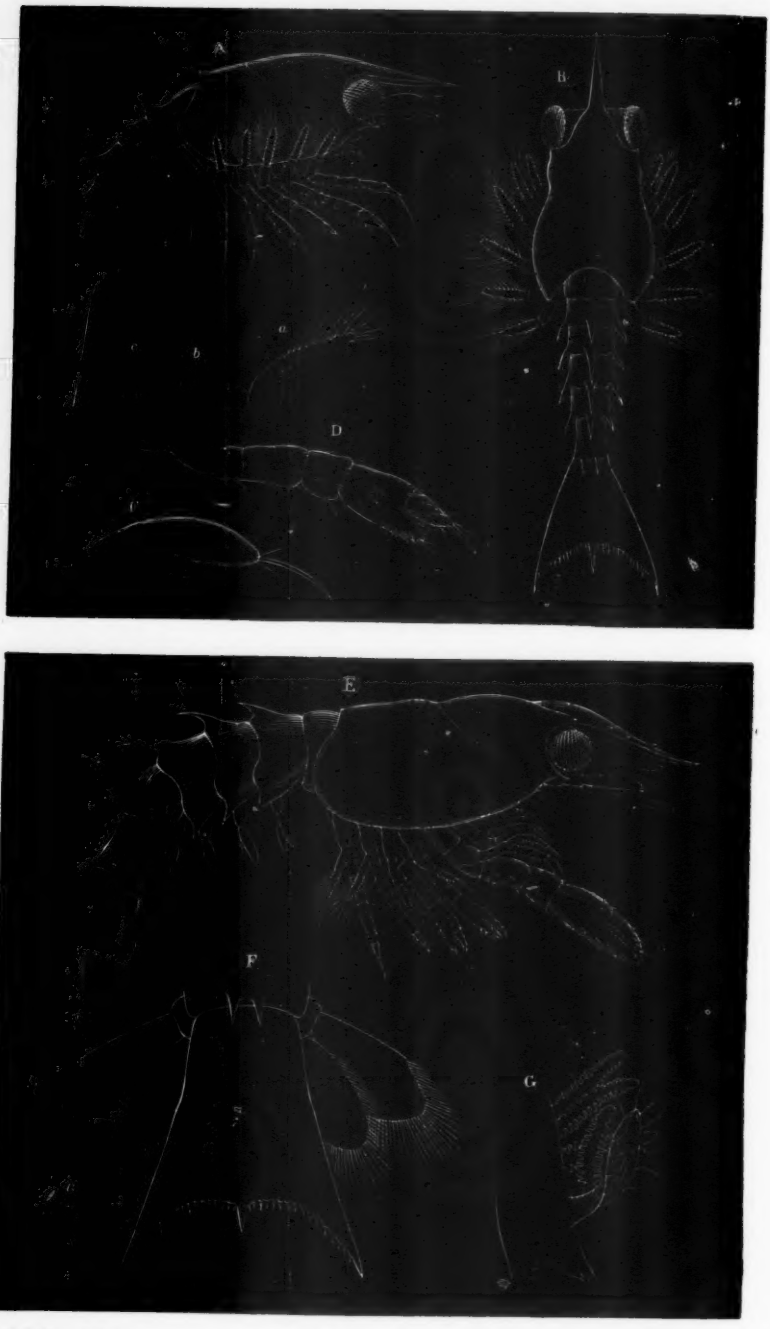
Notes on some new or imperfectly known forms among the Brachiopoda, etc., by James Hall. Published March, 1871; reprinted with explanation of figures, March, 1872.

Catalogue of the Pythonomorpha found in the Cretaceous strata of Kansas, by E. D. Cope. (Proc. Am. Phil. Soc., December. 1871.)

On the Families of Fishes of the Cretaceous of Kansas, by E. D. Cope. (Proc. Am. Phil. Soc.. January, 1872.)

Contributions to the Ichthyology of the Lesser Antilles, by E. D. Cope. (Trans. Am. Phil. Soc., vol. xiv.)

Description of the genus Protostega, a form of extinct Testudinata, and of species from Kansas and New Jersey, by E. D. Cope. (Proc. Am. Phil. Soc., March, 1872.)



S. I. S. from nature.